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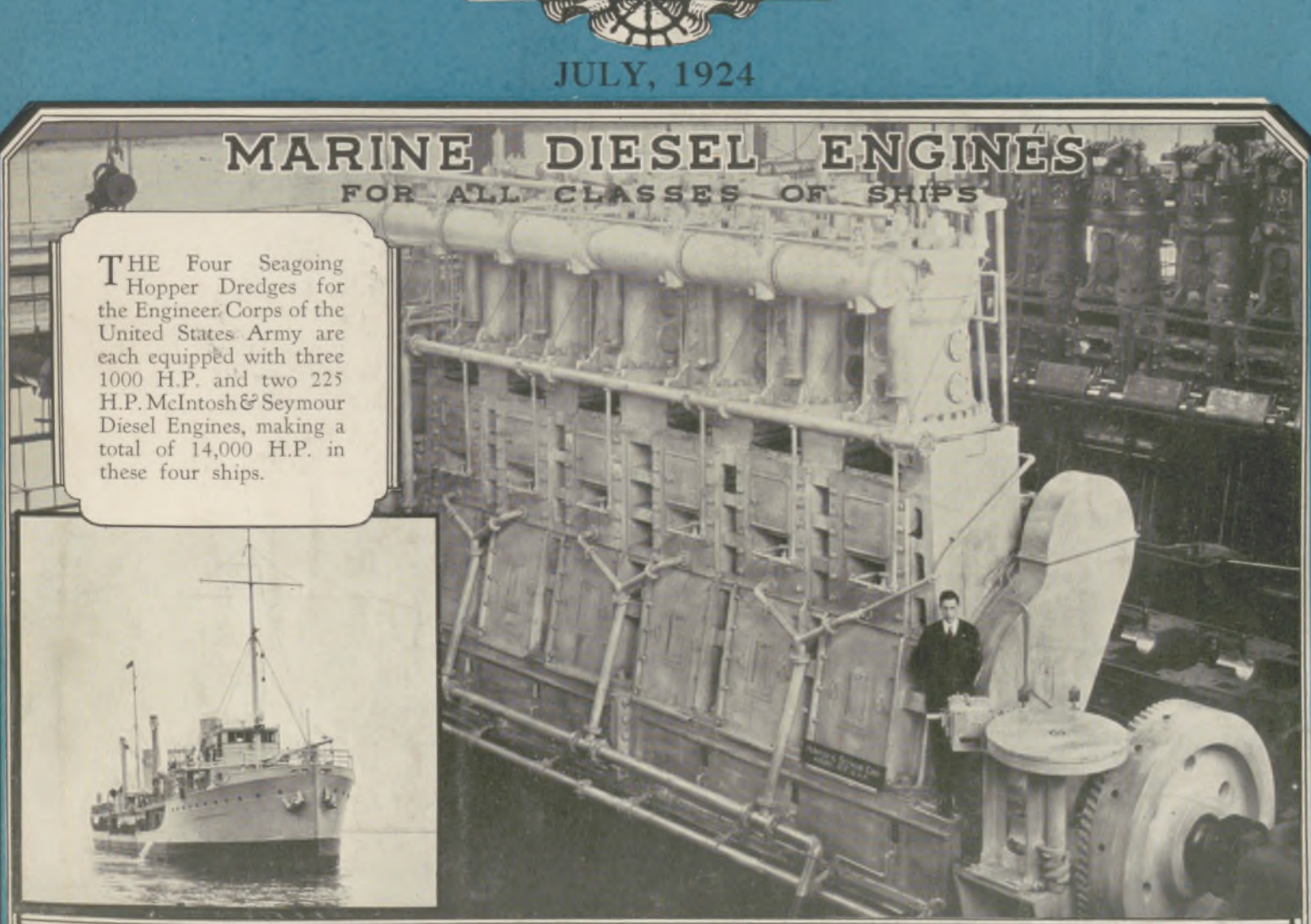
MARINE DIESEL ENGINES
FOR ALL CLASSES OF SHIPS

THE Four Seagoing Hopper Dredges for the Engineer Corps of the United States Army are each equipped with three 1000 H.P. and two 225 H.P. McIntosh & Seymour Diesel Engines, making a total of 14,000 H.P. in these four ships.



McINTOSH & SEYMOUR CORPORATION
MAIN OFFICE AND WORKS - AUBURN, N.Y.

Volume IX, No. 7 Price, 25 Cents

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Motorship

PROFUSELY illustrated with photographic reproductions of the newest designs in international merchant motorship and Diesel-engine construction and auxiliary equipment.

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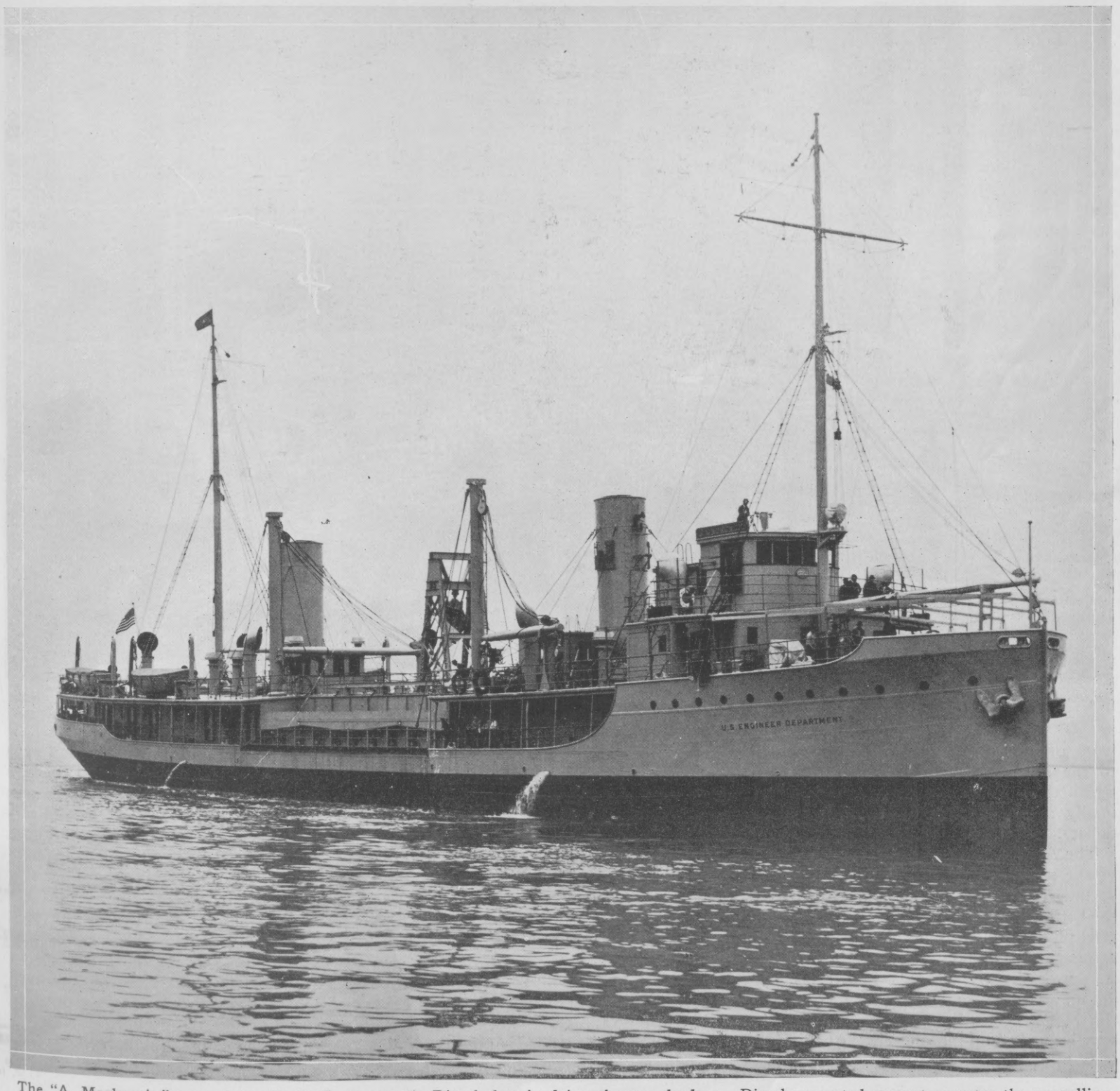
Diesel-Electric Hopper Dredge for U. S. Army

Electric Transmission From Three 1,000-b.h.p. Diesel Engines Furnishes Propelling Power and Operates Dredging Pumps. Flexibility, Economy, and Modern Equipment Characterize This Vessel

THE recent successful maiden trip of the new Diesel-electric dredge A. MACKENZIE from the yard of her building to the Hudson River brings into prominence the notable features of her design, particularly since she is one of the largest Diesel-electric ocean vessels so far built in this country. Leaving Chester, Pa., she proceeded to New York, thence up the Hudson to West Point, whence she returned to New York Harbor. As the entire trip was completed without any sign of hesitancy from her propelling machinery, it gives an initial confirmation of the trust



The "A. Mackenzie," one of the U. S. Government's Diesel-electric driven hopper-dredges. Diesel-generated current operates the propelling motors, runs the dredge pumps, and puts every detail of the operation of this ship on an ultra-efficient basis. Three more like it are nearing completion in addition to a big pipe-line dredge with Diesel-electric drive under construction and another contemplated

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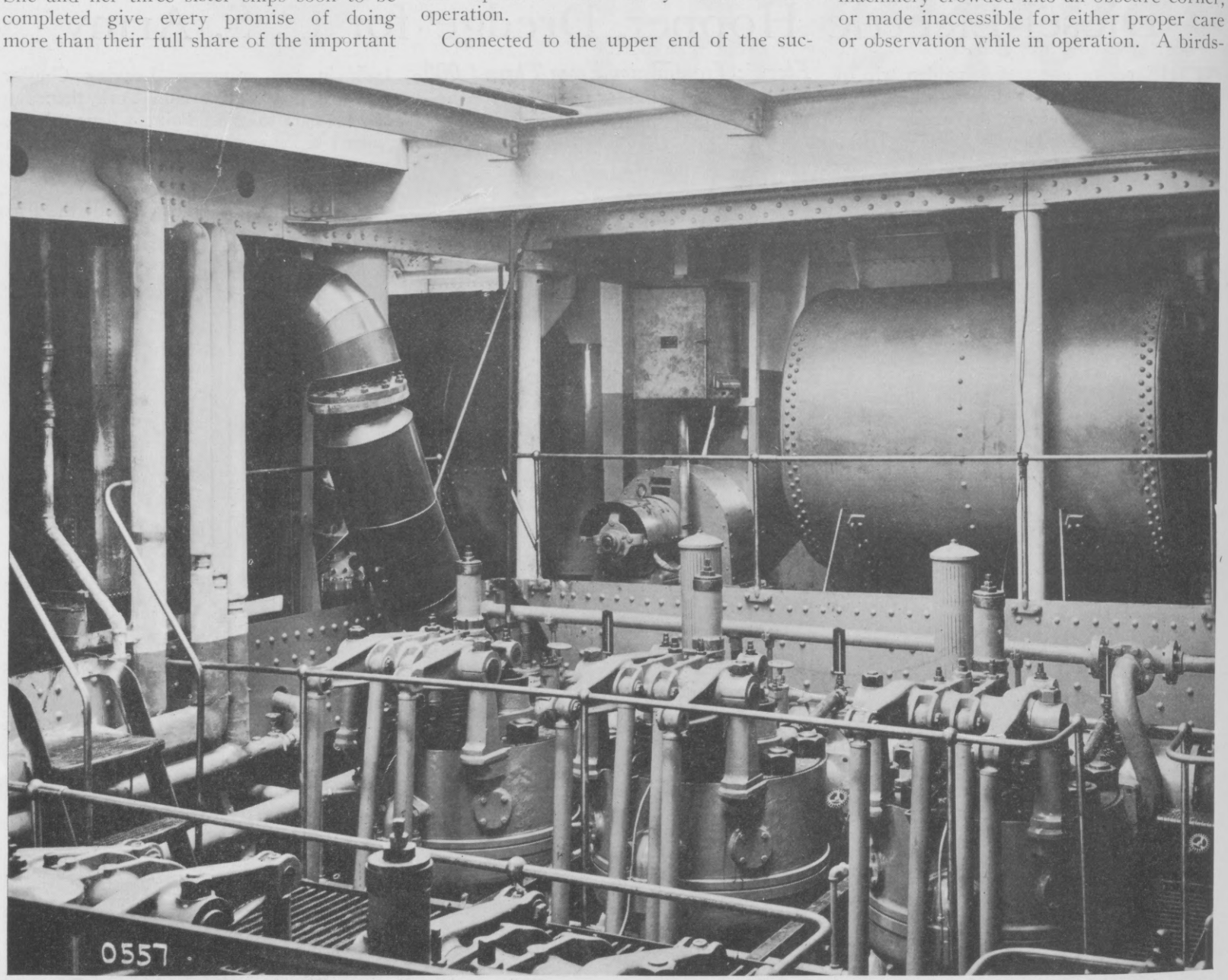
placed by her designers in the dependability and efficiency of the Diesel-electric drive.

Upon her return to New York she was put through exhaustive operating tests on actual dredging in the harbor, and in these tests she proved beyond doubt that her efficiency at work should fully equal her efficiency at sea. Built by the Sun Shipbuilding and Dry Dock Co. to designs by the Corps of Engineers of the Army she embodies many progressive innovations which well fit her for her intended duty. She and her three sister ships soon to be completed give every promise of doing more than their full share of the important work of keeping our harbor channels open to the ships of the world, a work upon which the Federal Government spends annually an average of about forty million dollars.

The A. MACKENZIE is a sea-going dredge of the suction type, and does her work by sucking the combined mud and water from the bottom of the channel through a 26-inch steel pipe capable of being lowered to reach a maximum depth of thirty-five feet. On its lower end is what is known as the "drag," a grid-like affair which plows up the bottom, loosening the mud so that it may be sucked up more easily. At this end also are secured the wire cables for raising or lowering the drag and its connecting piping, which together are known as the "ladder." The ladder when raised is housed in a well occupying the center section of the ship, and extending through the vessel vertically from keel to upper deck. The raising and lowering of the ladder is done by means of a ladder control windlass built by the American Engineering Company, and housed in its own deck house on the upper deck at the forward end of the well, where the operator can easily oversee the operation.

Connected to the upper end of the suction pipe of the ladder through a flexible coupling is the suction of the dredge pump, which comprises a volute single suction centrifugal pump of 26-inch suction and discharge, driven at 140 to 156 revolutions per minute by an 800 H.P., 480 volt, direct current Westinghouse motor. The discharge of mud and water from the dredge pump is into the four hoppers, situated abreast and to each side of the well. It is from these hoppers that the type-name of the dredge is derived. In the hoppers the mud settles to the bottom, while the water overflows and returns to the sea. When hoppers are filled with mud the ladder is raised, and the dredge proceeds to sea, where the dumping is done by the simple method of opening the hopper doors situated at the bottom of each hopper. For this operation there is provided a Hele-Shaw pump actuating a hydraulic plunger connected to the operating rods of the doors.

Her features of perhaps greatest interest to the marine world are embodied in her general engineering installation, which is a model of careful designing and spacing. Nowhere in her engine rooms is any piece of machinery crowded into an obscure corner, or made inaccessible for either proper care or observation while in operation. A birds-eye view of the propelling equipment would show us three main Diesels of a combined horsepower of 3,000, each driving a main generator, while on each of the two main propeller shafts is a main motor. Voltage of the main propelling system is 500, direct current being used, and current from the main generators is applied only to the main propelling motors and the dredge pump motor. For auxiliary purposes there are two auxiliary Diesels, driving generators producing current at 250 volts, which is used for operating every piece of auxiliary machinery on the ship, exciting the main generators and main motors, power for



Partial view of one of the 1,000-b.h.p. Diesel engines which furnish electric power on board the U. S. hopper dredge "A. Mackenzie." Note the sturdy construction

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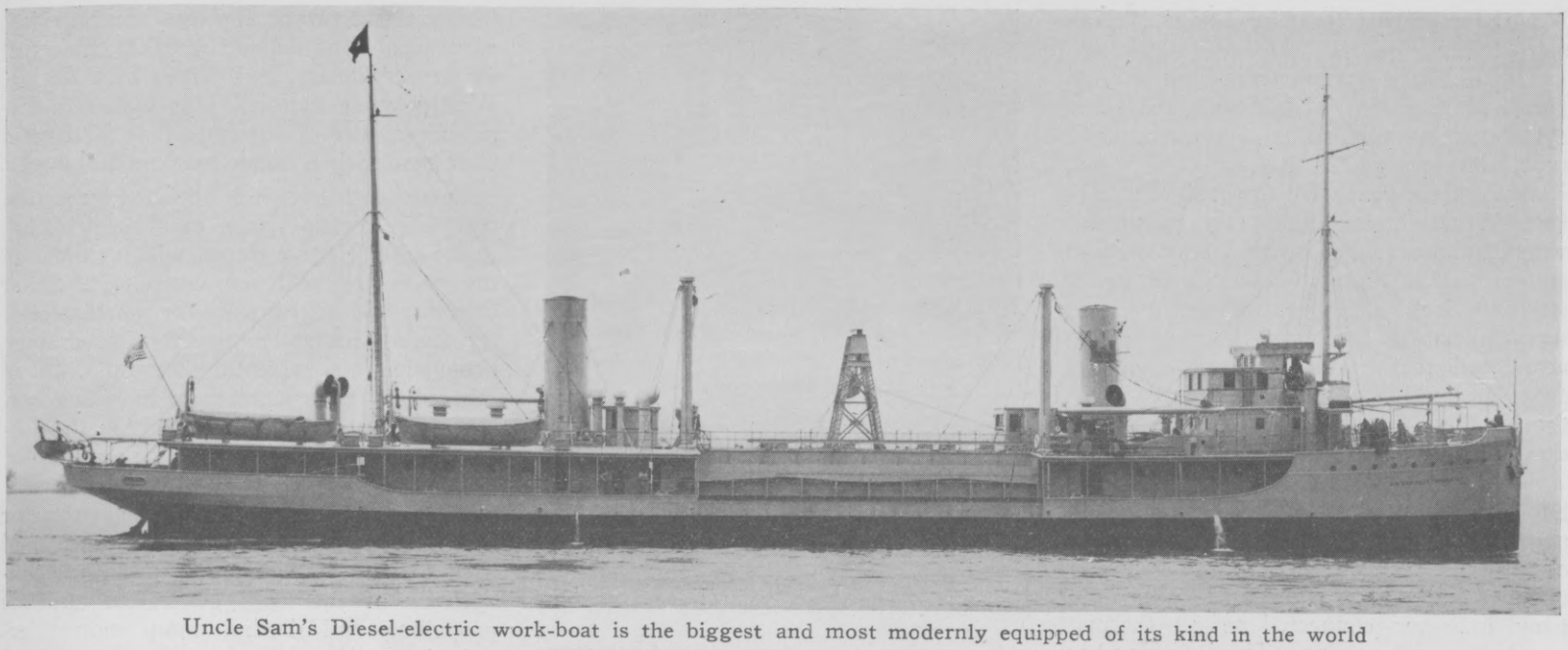
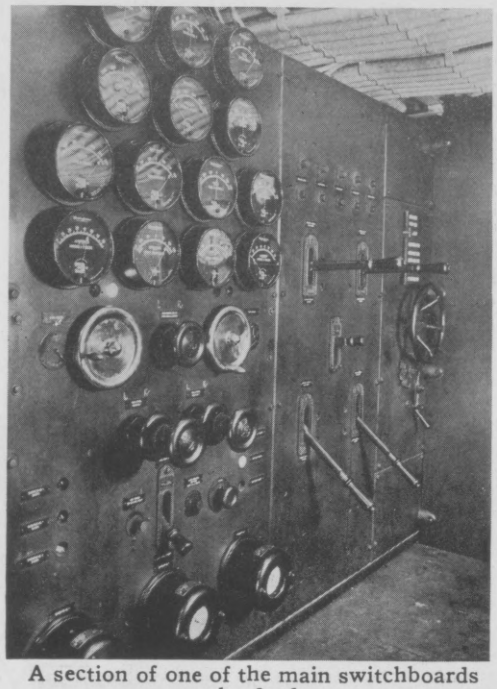


Uncle Sam's Diesel-electric work-boat is the biggest and most modernly equipped of its kind in the world

deck machinery and steering motor, cooking, heating of all living spaces, and for all other purposes required. In addition there is a 150 k.w. motor-generator set for converting the main current of 500 volts to auxiliary voltage of 250. The propelling installation is characterized by a high degree of flexibility, as will be seen from the eight various combinations possible as listed later in the description of the main distribution board.

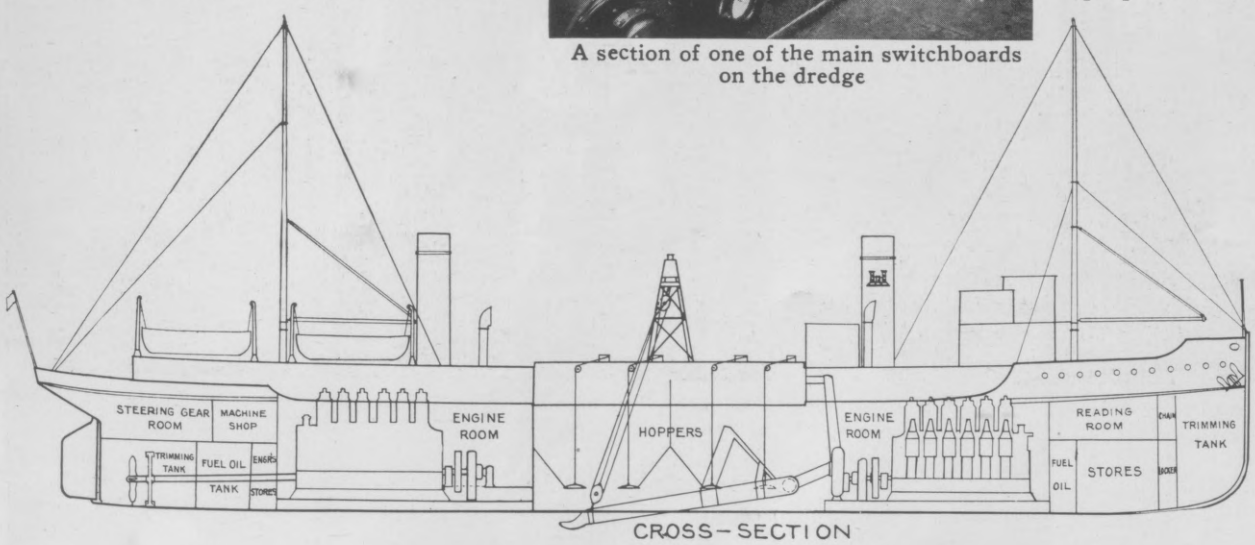
The main Diesels were built by McIntosh & Seymour, and are six-cylinder, four-cycle, air-injection, crosshead units, developing 1,000 b.h.p. at 150 r.p.m. They are of the builder's marine type so familiar to the marine Diesel engineer, but with minor alterations to fit them for driving generators. Each is direct connected to a 700 k.w., 500 volt Westinghouse generator of the totally enclosed type, separately excited,

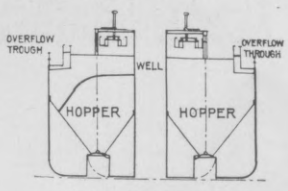


A section of one of the main switchboards on the dredge

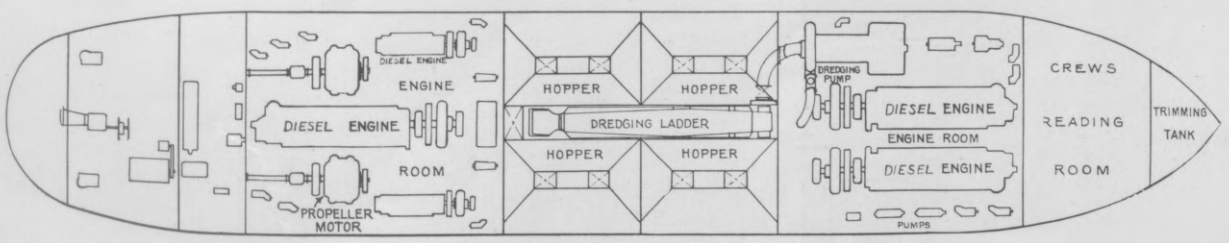
by current taken from the auxiliary generators.

Each main motor is a double-unit type, 480 volt Westinghouse motor, totally enclosed, and separately excited by auxiliary current. Each develops 800 h.p. at 90 to 110 r.p.m., which with both motors operating at full power is estimated to give the ship a speed of about eleven and a half knots. Each motor being of the double-unit type, consists of two individual field frames and two individual armatures mounted on a common shaft. Main motor bearings have each two lubricating oil rings, and also a gravity oil feed system. For circulating the oil in the gravity system, a Brown & Sharpe gear pump is geared to the forward end of the shaft and the oil is passed through an Elliot strainer for cleaning. Main motors are direct connected to propeller shafts, which are equipped with





SECTION THROUGH HOPPERS



Sectional diagrams of hopper dredge showing location of Diesel-driven generators, dredging pump, "sand sucker" and hoppers. Complete plans and engine-room lay-out were published in our series of July, 1922, and January, 1923

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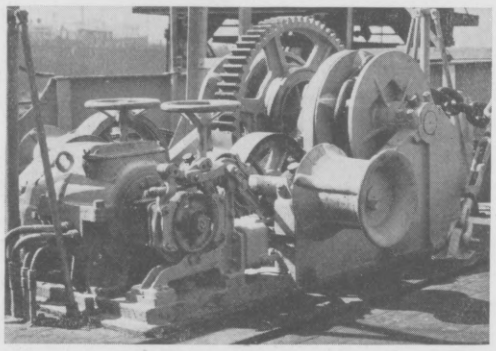
Kingsbury thrust bearings and McNab stern tubes.

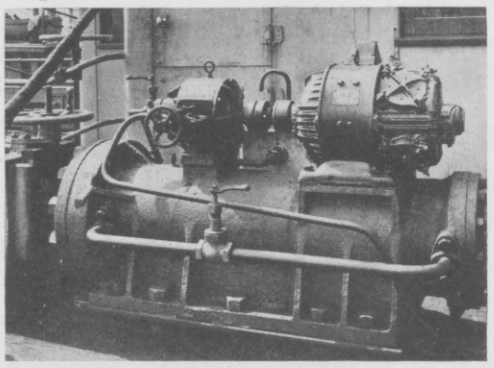
The auxiliary engines were built by McIntosh & Seymour and are of the four-cylinder, four-cycle, trunk-piston, stationary type, developing 225 h.p. at 275 r.p.m. Each is direct connected to a 150 k.w., 250 volt Westinghouse generator, compound wound, and arranged so that both may be run in parallel under conditions of heavy auxiliary load. An operating point of interest to note is that since the main generators and motors are separately excited from the auxiliary circuits, at least one of the auxiliary generators is kept in operation at all times.

A complete exhaust gas pyrometer system is installed on each Diesel engine, both main and auxiliary. Each system consists of a thermo-couple on the exhaust of every cylinder, with a Brown Instrument Company indicator connected to all thermo-couples on each engine. The indicator has a double-pole rotary switch so that the temperature of the exhaust from each cylinder can be read in turn. The advantages of this system are numerous, for it enables the engineer to tell with ease whether each cylinder is doing its assigned portion of the engine's work. The least change in the functioning of a cylinder is immediately noticeable in a change of the exhaust temperature from that cylinder, and its cause can be traced and corrected. The saving of fuel assured by the proper operation of all cylinders is very great, while the saving of wear and tear on moving parts and bearings obtained by equal division of work among the cylinders is important.



Electric anchor windlass has up-to-the-minute braking and control equipment

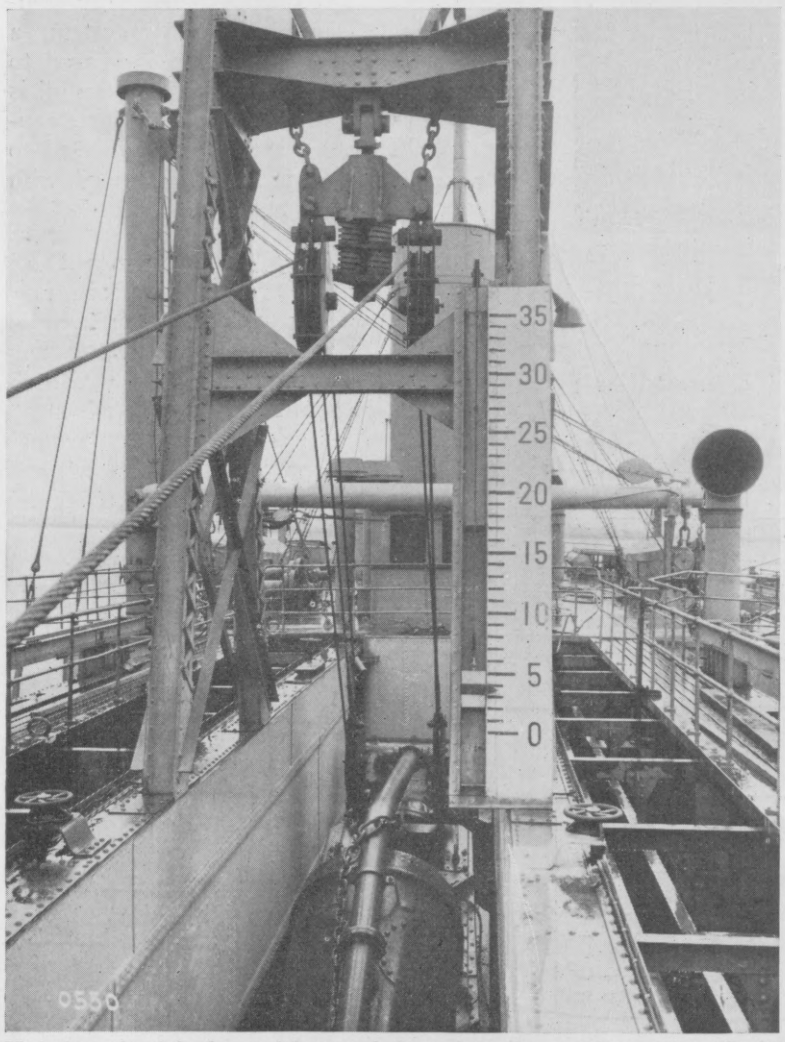
The main generators, main motors, and dredge motors, being totally enclosed, are each equipped with a forced ventilation system, both suction and discharge for which are above the upper deck. For this system, six Sturtevant Blowers are provided, each capable of delivering 6,000 cubic feet of air per minute, and driven by a 7.3 h.p. Westinghouse motor. This insures a rise in temperature of not more than 50 degrees Centigrade when under constant full load.



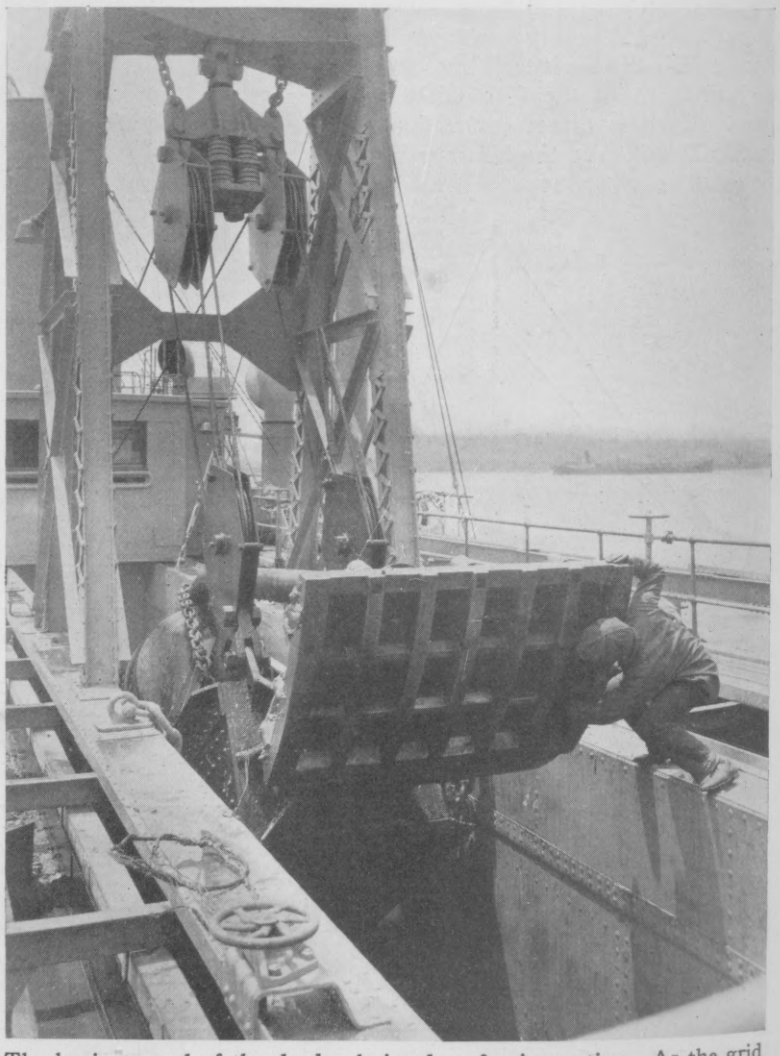
This electro-hydraulic cylinder opens and closes the hopper valves for discharging contents at sea

Power distribution is obtained by a most complete Westinghouse main switchboard in the after Engine Room, which carries all the necessary switches, contactors, circuit breakers and instruments for the control of the main generators, auxiliary generators, propulsion motors, motor generators, and all other distributing equipment including current for the distribution panels in the forward engine room, where the power for the engine-room auxiliaries is carried. Of particular interest is the cam contactor set-up group operated by hand wheel and used to make the field and armature connections of the main generators and the propelling and dredge pump motors required for different conditions of operation. This mechanism is made practically accident-proof by a locking device which prevents movement of the hand wheel when power is on, so that the contactor switches cannot be opened when carrying current. An indicator above the hand wheel shows which of the eight different combinations possible is set up at any time, these possible combinations being as follows:

Set-up No. 1—All circuits open.
Set-up No. 2—Generator No. 1 to Motor No. 1.
Generator No. 2 to Motor No. 2.
Generator No. 3 to Dredge Pump Motor.



Hoisting derrick for raising and lowering the suction pipe. It is operated by a special electric-driven windlass



The business end of the dredge hoisted up for inspection. As the grid passes over the bottom, the action of the water loosens the sand

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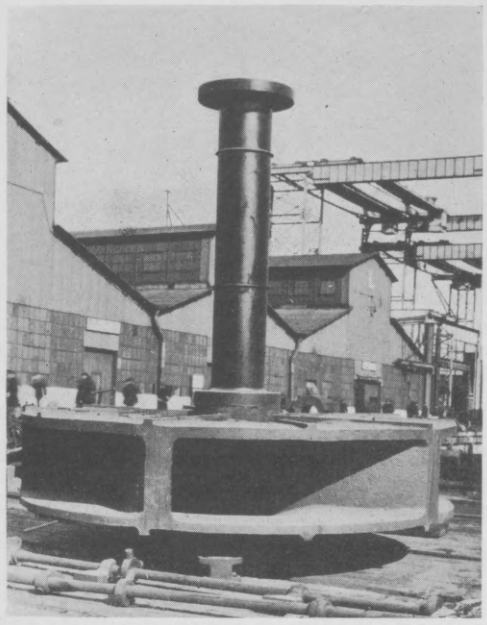
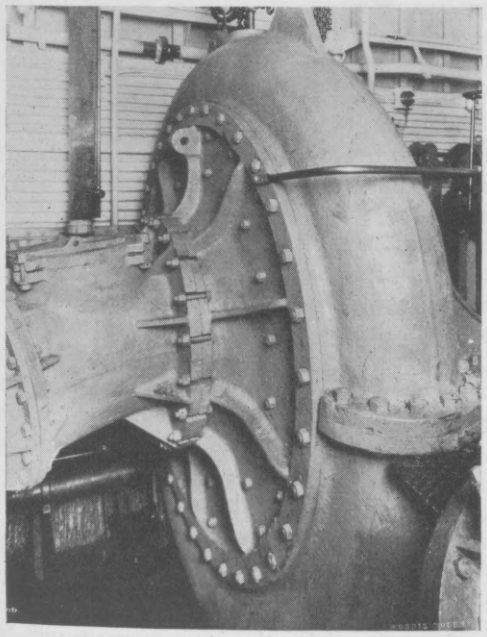
Set-up No. 3—Generator No. 1 to Motors No. 1 and No. 2.
Generator No. 3 to Dredge Pump Motor.
Set-up No. 4—Generator No. 2 to Motors No. 1 and No. 2.
Generator No. 3 to Dredge Pump Motor.
Set-up No. 5—Generator No. 2 to Motors No. 1 and No. 2.
Generator No. 1 to Dredge Pump Motor.
Set-up No. 6—Generator No. 3 to Motor No. 1.
Generator No. 2 to Motor No. 2.
Set-up No. 7—Generator No. 1 to Motor No. 1.
Generator No. 3 to Motor No. 2.
Set-up No. 8—Generator No. 3 to Motors No. 1 and No. 2.

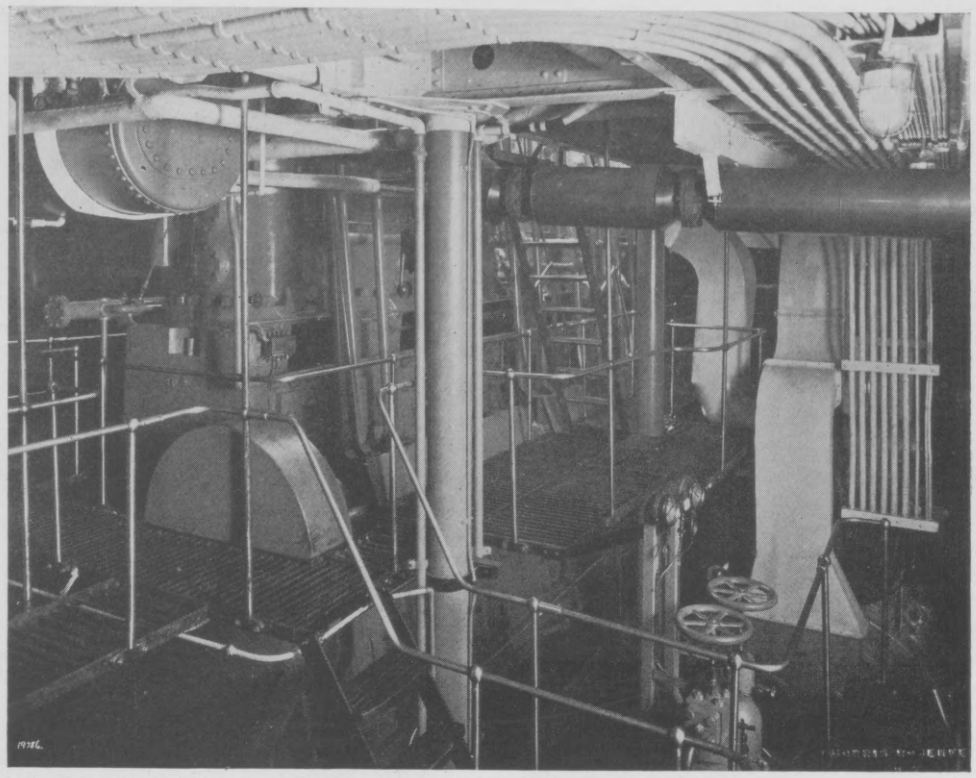


Spare rotor for the dredging pump



A close-up of the big dredge pump

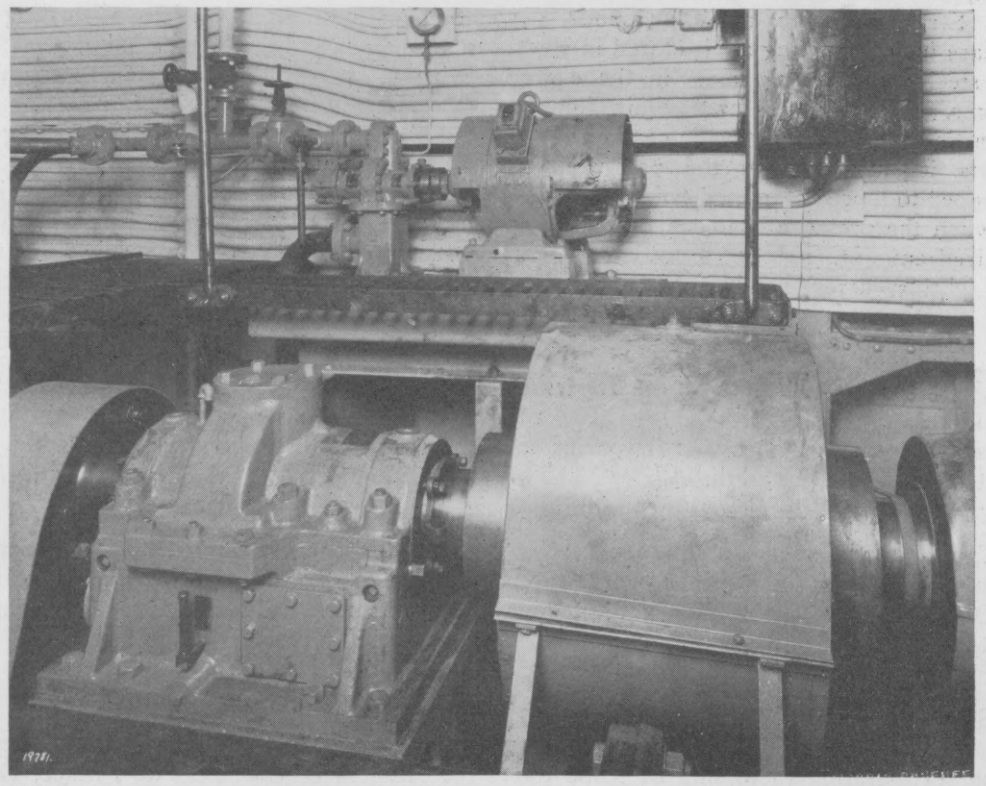
By means of the pilot house control desk, the captain is enabled to start, stop and reverse the main propelling motors direct from the bridge without the delays incident to the usual system of engine room telegraphy. These changes he makes with his own hands without any appreciable effort. The desk is equipped with two hand wheels, one for controlling each propelling motor. In addition, there are voltmeters for each main generator and each propelling motor, ammeter and speed indicator for each propelling motor, and indicating lamps for showing the position of main generator contactors, so that at a glance the captain may read the conditions existing in the engine rooms. A similar installation with an engine-room telegraph is provided at the main switch board, and control may, if desired, be shifted to that point.



Middle-grating view showing cylinders of Diesel engine. Although every cubic foot of space is used on these boats, there is no crowding

The steering gear is of the electric type, built by the American Engineering Company, and driven by a 30 H.P. Westinghouse motor. Operation is by distant contactor control from the pilot house. The steering engine itself has the rudder stock connected by links to the crossheads on a right-and-left-hand threaded drive shaft operated through a double reduction gear from the motor. A suitable brake is provided, as are also cut-outs at the hard-over positions. The rudder angle indicator is electrical, built by Chas. Cory & Sons.

For auxiliary purposes nineteen rotary pumps built by the Northern Fire Apparatus Company are provided. These are for handling lubricating oil, fuel oil, distillate transfer, fresh water, and water for the sanitary system. There are also six Worthington centrifugal pumps. These are the fire and bilge pump, engine circulating water pumps, and the jet pump. The latter is used for pumping water into or out of the hoppers, and for supplying a jet of water at



Tilting-block thrust bearing between driving motor and dredge pump; under the casing is a flexible coupling. Advancing-stem valve like the one shown in the upper left-hand corner, are widely used on the dredges

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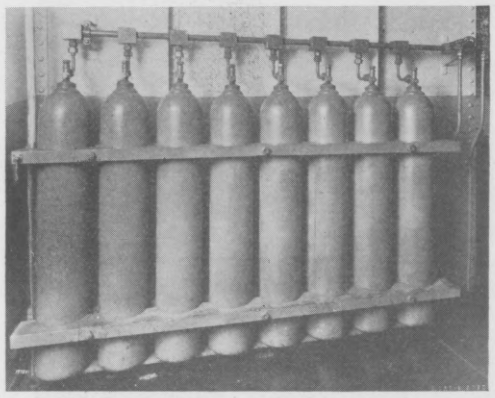
the drag for assisting in breaking up the mud at the bottom when dredging. All pumps are driven by Westinghouse motors, and all are equipped with button control for starting and stopping. The horsepower of the jet pump motor is 150, of the fire and bilge pump motor 50, of the engine circulating water pump motors two are 20 and two



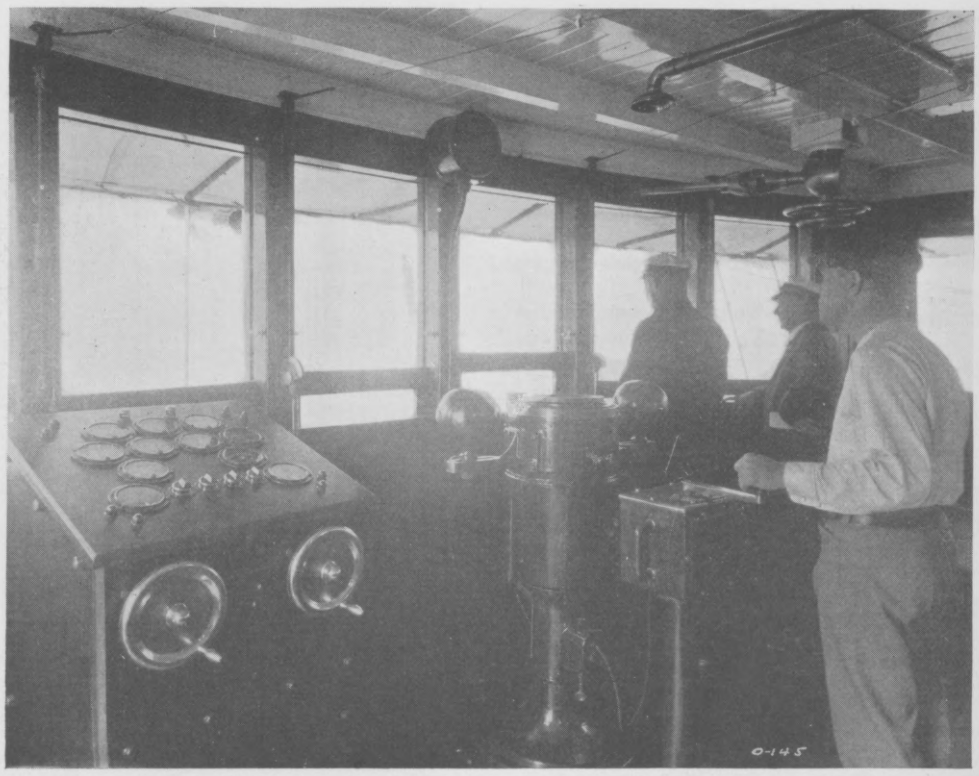
Lux-Rich extinguishing plant fully protects the hopper dredges

are 15, while for the other pumps the majority of the motors are 3 horsepower and the remainder 5.

No fire is used on the vessel whatsoever, and for cooking two Edison Electric Appliance Company electric ranges are installed. Galley water is heated by electric heaters built by Westinghouse. The galley is also equipped with a Hobart combined electric coffee grinder and dough mixer. Heating of water for laundry purposes is likewise done by electric heaters. Heating of living spaces is done entirely by electricity as well, for which purpose many Westinghouse air heaters of the convection type are provided.

Two Worthington auxiliary air compressors are installed, one for supplying air for engine sarting at 350 pounds per square inch, and the other one for operation of the Strombos siren at 100 pounds per square inch. Starting air is stored in riveted steel maneuvering tanks in the engine rooms. The compressor for air for the siren is fitted with automatic control which starts its motor when the pressure has dropped to a predetermined point, and stops it when the pressure has been raised to the desired amount.

Lighting current at 115 volts is generated



Precision of control for all the movements of this modern dredging ship is assured by the thoroughgoing application of the electric drive principle. The controllers here shown stop, start, and reverse the propelling motors and run the pump

by two motor-generator balancer sets, driven by auxiliary current at 230 volts. Each of these sets is of 5.5 k.w., and they are arranged to operate either separately or in parallel.

Refrigeration is provided by a Johns-Manville refrigerating machine installed on the lower deck aft. This machine will maintain a temperature under tropical conditions of 40 degrees Fahrenheit in the cold storage room and will in addition produce about 250 pounds of ice per day.

For emergency purposes there is a 25 k.w. General Electric gasoline engine driven generator, which is intended to be used for running the auxiliary generators as motors for starting in case of a loss of starting air under any condition where all Diesels are stopped. It can also be used under similar conditions for driving the compressor for building up the pressure of the starting air in the maneuvering tanks.

Heating of fuel oil before injection into the engines is done by means of hot water, which is itself heated by either of two methods. One method is by means of electric immersion heaters installed in a fixed tank, the equipment including a starting panel and adequate temperature instruments. The other method is by means of heating coils installed in the exhaust piping of the Diesel engines.

For extinguishing fire in the fuel oil storage spaces the ship is equipped with the Lux liquid carbon dioxide system. The remaining spaces are protected by numerous connections with the fire mains, and Pyrene fire extinguishers are placed in convenient localities.

The machine shops is unusually well equipped for a vessel of her size, there being installed a 30-inch gap lathe, shaper, power hack saw, a large radial drill press, and the usual motor driven emery wheels. This equipment seems ample to allow practically all the ordinary repair and upkeep work to be done on the ship itself.

In completion of her very adequate equipment there are installed on deck an anchor windlass, two capstans and two double drum cargo winches of the American Engineering Co., with Westinghouse motors.

VAN DYKE I, the first of the Ingersoll-Rand-G.E.C. Diesel-electric tugs for the Atlantic Refining Co., was launched at Staten Island on June 7th.

The Neptune shipyard, Hamburg, Germany, is said to have received orders for a 7,500 tons motorship and for a 6,400 tons motorship from Norwegian shipowners.

Sulzer Diesel engines of 6,400 s.h.p. on twin-cylinders will be installed in a Houlder Line refrigerating motorship of 9,500 tons d.w. building at the Fairfield Shipyard, Govan.

A double-acting Diesel engine of 2,700 shaft h.p. in four-cylinders is being built by the North British Diesel Engine Works for a hull not yet decided on.

VARANGER and NORDANGER are the names of the two large Werkspoor Diesel-engined motor-tankers building at the Netherlands Shipyard for Norwegian owners.

THEOPHILE GAUTIER is the name of the 9,000 tons passenger motorship building at the Ateliers et Chantiers de France, Dunkirk, to the order of the Services Contractuels des Messageries Maritimes.

It is expected that the 6,000 s.h.p. Challeassiere (Sabbathé) Diesel engine recently ordered by the French navy will be installed in one of the two 3,000 tons submarines to be constructed under the second part of the French Naval program for delivery in 1925-6.

According to a British report, Vulcan-Foettinger reversible hydraulic transmission in conjunction with Diesel engines will be installed in two 12,000 tons 6,000 s.h.p. tankers building at the Vulcan Works, Hamburg-Stettin, for the German-American Petroleum Company, which is a subsidiary of the Standard Oil of New Jersey.

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Shipping Board Plans World's Greatest Motor Liners

Congressional Approval Expected on Plans for Two Diesel-Driven Transatlantic Passenger Ships of About 28,000 Tons Gross

EVERYONE who has at heart the interest of America's Merchant Marine will feel a certain amount of pleasurable excitement over the announcement that the Shipping Board has drawn up plans for two huge transatlantic passenger motor liners, which will be virtually Diesel-driven duplicates of the successful steamer, GEORGE WASHINGTON. Economical cargo ships are the keystones of any great mercantile marine, but it is also essential that leadership should be achieved if possible in passenger service. It does not inspire, nor does it contribute to the success of freight-carrying marine, if the majority of the Americans cross the high seas under a foreign flag. Passengers who spend a week on an efficiently operated American vessel are likely to become well impressed with the feeling that Americans can also successfully operate cargo boats. "No better notice could be served that the American flag is to permanently fly on the seven seas than the building of these two great motorships" —said Chairman T. V. O'Connor, in announcing the proposed construction and conversional program. "By adopting the Diesel engine the American Merchant Marine is ensured a rosier future."

Gibbs Bros., the naval architects who prepared the plans for reconditioning the LEVIATHAN, have been selected to draw up the plans for the new Diesel-driven liners, which are quadruple-screw about 28,000 tons gross register, Both vessels will be identical in every respect. While it is probable that four double-acting Diesel engines of about 6,000 s.h.p. each will be installed, every responsible maker of large Diesel engines will be given consideration and the opportunity to bid. There is even a possibility that electric-drive may be adopted. The exact power has not yet been decided. One thing that has been made clear is that the Diesel engines will be constructed in the United States, but this does not bar European designs being adopted if it can be demonstrated that such are in advance of anything yet produced in this country and more suitable for domestic manufacturing and operating conditions. These vessels will be larger, faster and of greater total horsepower than any of the various Diesel-driven passenger liners now constructing in Europe, but division of the power into four direct-drive units (or more engines if electric transmission is used) means that a margin of safety has been provided by reducing the engine and cylinder power to below that of European motorships now building.

From a technical aspect there is no reason why these ships will not be a success in every way, and from a commercial viewpoint they undoubtedly must be a success. Therefore, there is every reason that they shall be constructed at once, or as soon as Congress convenes.

The daily press, while opposed to new ship construction in general by the Board, appears to be sympathetic towards these epoch-marking ships. It understands the difficulty of providing private capital for their construction at this time and realizes the necessity of strengthening our merchant marine with their aid. Favorable congressional attitude also is anticipated as approval has already been given by members of the House Appropriations Committee as well as by the Senate Committee of Finance.

The Shipping Board, having noted through the public press the development that is going on abroad in building passenger motorships, is impressed not only with the importance but with the absolute necessity for taking action along the same lines to keep abreast of this very important development.

In order to accomplish this, the Shipping Board is having plans developed for a passenger motorship that it is hoped will compare favorably at least with the best results obtained abroad.

Special attention will be given to all the technical details to insure proper strength and reliability in all engineering features and the safety of the ship. In the design of these vessels special attention will also be given to their fitness to serve as auxiliaries to the Army and Navy in time of war.

While luxurious appointments and equipment will not be attempted, every effort will be made to secure vessels that will carry out the American idea of simplicity and absolute reliability, with the necessary comfort.

Propelling Machinery and Space Occupied

An interesting sidelight on the question of tonnage ratings and the unfairness to motorships of the rating methods now in force is given by HET SCHIP. According to figures compiled from the particulars of 490 ships representing the various types of modern propelling machinery, the cubic space occupied per indicated horsepower is as follows:

Compound steam engine	30.0 cu. ft. per i.h.p.
Triple expansion steam engine	33.2 " " " "
Quadr. expansion, steam engine	34.2 " " " "
Turbine reduction gear	26.5 " " " "
Oil engines	19.1 " " " "

The unfairness of ascribing the same net tonnage to motorships as to steamships is given additional emphasis by these figures.

Large European Passenger Motor Liners Now Building

(Arranged in order of power)

Owners	Tonnage	Horse-power (Indicated)	Name of Vessel	Hull Builder	Speed (knots)	Approx. Daily fuel-consumption	Type of Diesel Cycle	Make of Diesel Engine
Union Castle Line	20,000 g.	20,000	UNION CASTLE	Harland & Wolff	18	70 tons	4	Harland-B. & Wain.
Royal Mail Line	22,000 g.	16,300	ASTURIAS	Harland & Wolff	16	50 tons	4	Harland-B. & Wain.
Royal Mail Line	22,000 g.	16,300	ALCANTARA	Harland & Wolff	16	50 tons	4	Harland-B. & Wain.
Swedish American Line	23,500 dp.	16,300	GRIPSHOLM	Armstrong-Whitworth	18	50 tons	4	Burmeister & Wain.
Union S.S. Co., New Zealand	17,000 g.	13,900	AORANGI	Fairfield Shipbldg.	17	47 tons	2	Fairfield-Sulzer
Netherland S.S. Co.	21,200 dp.	11,000	P. C. HOOFT	Chantiers Loire	15.5	37 tons	2	Sulzer
Hamburg South America Line	14,200 g.	9,400	MONTE SARMIENTO	Blohm & Voss	13	30 tons	4	B. & V. Augsburg (Reduction Gears)
Hamburg South America Line	14,200 g.	9,400	Unnamed	Blohm & Voss	13	30 tons	4	B. & V. Augsburg (Reduction Gears)
Houlder Line	9,500	8,000	Unnamed	Fairfield Shipbldg.	14½	25 tons	2	Fairfield-Sulzer
Brazilian Natl. S.S. Co.	8,500 g.	7,800	Unnamed	Brazilian Natl. S.S. Co.	15	24 tons	2	Sulzer
Rotterdam-Lloyd Line	12,000 g.	7,000	Unnamed	De Schelde Co.	14	22 tons	2	Schelde-Sulzer
Not Given	12,000 g.	7,000	Unnamed	John Brown & Co.	..	22 tons	2	Brown-Sulzer
North German Lloyd	9,450 g.	6,500	Unnamed	Vulcan Works	13½	20 tons	4	Vulcan-Augsburg (Reduction Gears)
Services Constructuels des Messageries Maritimes	10,300 g.	5,400	Theophile Gautier	Chantiers de France	14	15½ tons	2	Sulzer

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New Model of Well-Known Diesel Engine

Modification in Frame Structure in Werkspoor Design; Separate Cylinder-Liner Retains Intensive Cooling Around Combustion Space

SO familiar is the vertical and diagonal steel-column frame design of the Holland-Werkspoor single-acting marine Diesel engine of over 12 years' standing, that any modification of this form of construction will be studied with not a little interest by all engineers. A new model just being introduced retains with but few exceptions the main features for which this design has become universally known. And, it would seem that some of the experiences of their licensees working in co-operation with Werkspoor engineers have been incorporated, for the general appearance of the new engine resembles recent American Werkspoor productions rather than the older European profile. A bedplate of unusually deep and massive section is employed and is tied to the structure of the engine by means of the long steel tie-rods formerly employed for the same purpose. However, cast-iron frames astride the main bearings—similar to those in recent Werkspoor stationary engines—now replace the diagonal steel rods formerly used. But it should be mentioned that from the very first all marine engines put out by this company had cast-iron columns at the rear for supporting the crosshead guides, a function which, of course, is retained in the framing now used.

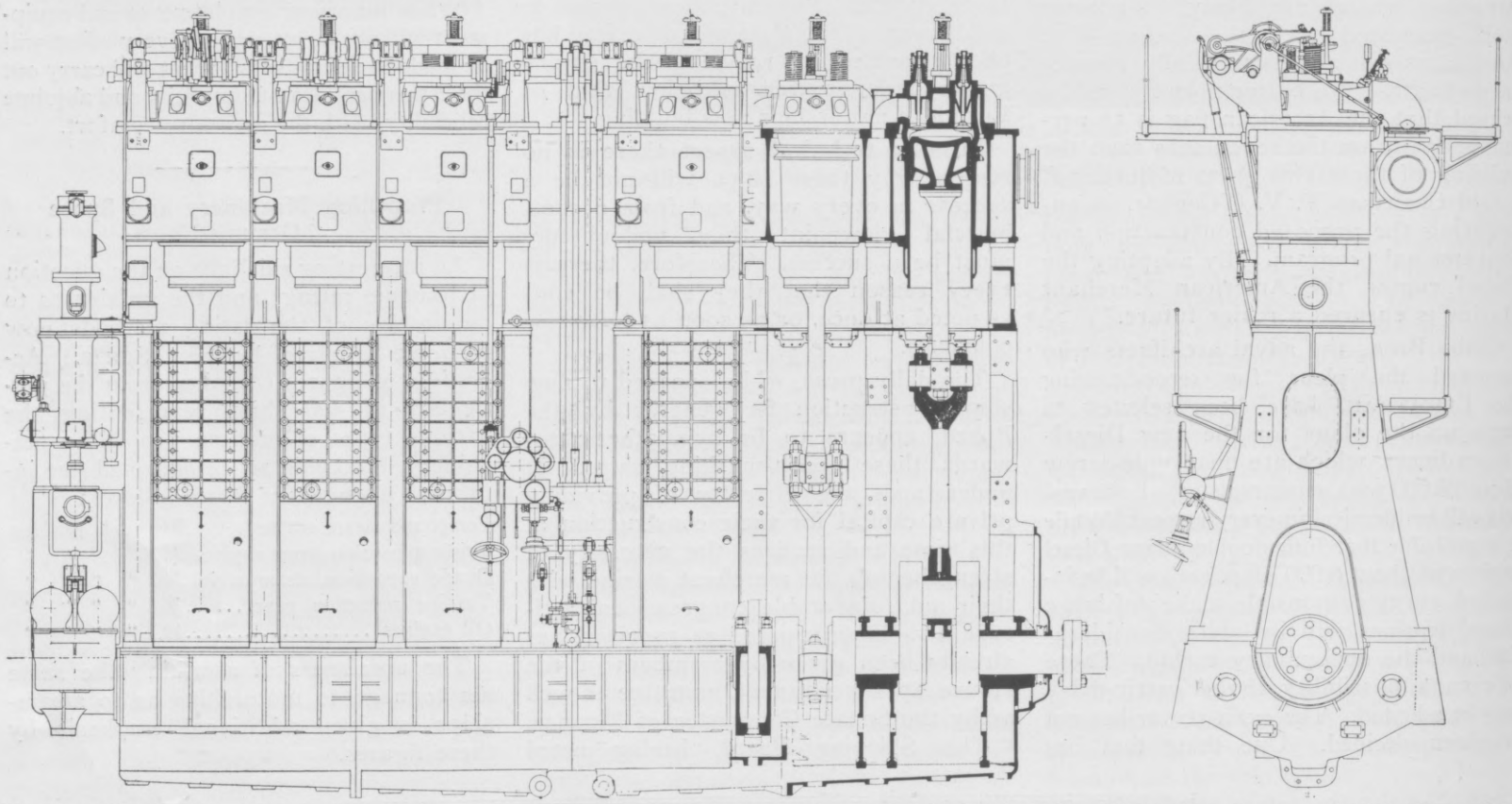
Locating the frames in the planes of the main bearings makes it possible to use a narrower bedplate than is the case with some designs in which columns opposite the connecting rods must be placed far enough out to clear the swing of the crankpin boxes. A-frames, as used in this design, make possible the continued employment of the through-running steel tie-rods which have characterized it for more than a decade. With columns located in the planes of the connecting rods — the arrangement common to steam-engine practice, the use of forged tie-rods is not convenient and the castings alone are depended upon to take the tensile stress. In the design under consideration the advantages of both types are combined. Steel members capable of being accurately determined as to size and strength, take up the tensile stress and the transverse cast-iron A-frames assist in imparting to the structure that rigidity which is demanded by marine service.

Crosshead guides are now mounted on bridge plates located between pairs of frames, machined strips being provided for the purpose. The opposite side, of course, remains wide open (except for splash guards) for easy inspection and keying-up.

Surmounting the entire structure is the well-known cast-iron cylinder beam, which also forms the water-jacket. It amounts essentially to a box-girder stiffened between cylinders by means of unbroken transverse webs. Forming a bridge for transmitting the load from the axis of the cylinder out to the four steel tie-rods grouped about it, this cylinder-beam takes up in itself practically all the bending stresses that occur in the engine and protects delicate surfaces, such as crosshead-slides and journals against deflections. Their alignment and cool working is thus assured.

The cylinder-box, indeed, forms an effective supplement to the bedplate, and the two together constitute a strong backbone for the entire engine. A-frames, already discussed, are merely distance-pieces between the cylinder-box and the bedplate and as they are jointed on the longitudinal plane of the engine, it is an easy matter to assemble and dismantle them. In the rare event that the removal of a crankshaft should ever become necessary, one-half of each of the A-frames can be slid out sideways and the shaft lifted out.

Cooling the cylinder and combustion spaces is carried out in this design according to the method which has come to be firmly established in Diesel engineering practise. By casting a part of the cylinder barrel integral with the cylinder head, the use of heavy flanges and accumulations of metal around the combustion space is avoided. Cooling water can circulate freely and the abstraction of heat from the metal sur-



The latest Werkspoor types embodying new features in the frame construction and cylinder barrels. There is only a nominal load on the joints. Bore and stroke are 29.92″ and 47.24″

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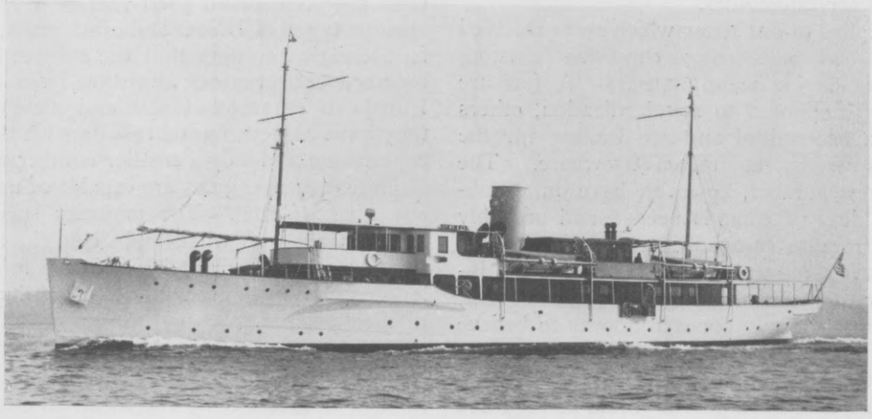
rounding the combustion space is accomplished in an efficient manner. No departure from this principle is involved in the latest design, but in addition the possibility of renewing cylinder liners without at the same time scrapping cylinder heads is also provided for should they become worn by ash-content fuel oil.

As will be apparent from the longitudinal cross-section reproduced herewith, the cylinder barrel extending down from the head casting is still used, but at a point far enough down to clear the main joint between the cylinder head and the water-jacket a pair of bolting flanges is provided on the liner. All the advantages of free circulation around the combustion space are preserved, because that part of the liner near the main joint remains as before. The liner joint now used is not subjected to the longitudinal loads imposed upon the head and its joint to the cylinder-box, as will be apparent from a little reflection. Since the liner joint need be made up only hard enough to insure gas tightness, without being subject to any axial pull whatever, flanges and bolts can be made light. A glance at the cross-section shows that a bulky joint has been avoided and that cooling has not been interfered with.

The use of the new construction has not affected the employment of the removable cylinder extension, by means of which pistons can be taken out from below. In slow-speed Werkspoor engines, the cylinder skirt has not been water-cooled, but a cooling water-jacket is cast integral with the cylinder extension of the new design. Cooling of this part was first adopted by them in their submarine type engines during the war.

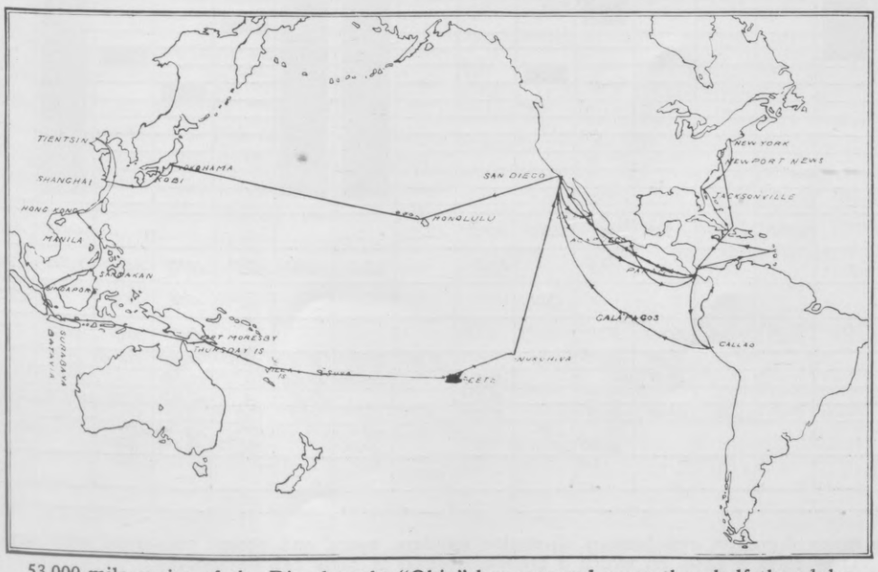


Record Polynesian Cruise of Diesel Yacht "Ohio"

More Than Half of the Surface of the Globe is Spanned by the Voyages of this Graceful Yet Sturdy Craft. Her Engines Functioned With No Delays for Repairs and Few for Taking on Fuel

ON May 8th the yacht OHIO, owned by E. W. Scripps, arrived at New York and docked at Marine Basin, Brooklyn. She had left Newport News in December, 1922, and in these 16 months had made the remarkable record of travelling 53,000 miles, exploring mysterious oceans under tropical skies and visiting in the far distant Orient.

The cruise first led to the West Indies, then to Panama and San Diego, California. From there the yacht visited Hawaii, Japan, China, the Philippine Islands, Borneo, Straights Settlements, Java, New Guinea, New Hebrides Islands, Fiji Islands, Society Islands and the Marquise Islands and then returned to San Diego. From there a cruise was undertaken to the West Indies stopping at La Paz, Lower California en route. Came back to the Pacific Ocean and on returning the West Coast of South America to Callao, Peru, permission was obtained to land at the Galapagos Islands, a penal colony of Peru.



53,000-mile cruise of the Diesel yacht "Ohio" has spanned more than half the globe

After visiting the Islands, where many interesting things were seen, the voyagers again returned to San Diego and from there to Acapulco, Mexico. They were the first boat to put into this port since the revolutionists had left and aided stranded Americans there by hailing a Pacific Mail steamer with their wireless, causing the steamer to stop at the port and to take off the refugees. From there they went through the Panama Canal, Jamaica, Cuba, Florida, Baltimore, and arrived finally at New York. The map indicates the course which they took and shows the perfect confidence which these yachtsmen had in visiting places far out of the way of steamer traffic and depending entirely on their Diesel engines to see them safely through.

This cruise furnishes another striking proof of the adaptability of the Diesel engine to pleasure boats and the captain and crew have nothing but praise for the efficiency and performance of their ship in all kinds of weather and conditions. The yacht is a credit to the designers, Cox and Stevens, and to the builders, the Newport News Shipbuilding and Drydock Co. It shows what kind of boats can be built right here in this country. This is especially true in regard to the Diesel engines on board. The power is supplied by two 350 b.h.p. Winton Diesels and judging by what Captain Heimbrod and Chief Engineer Brown have to say about the high efficiency of these engines, it is evident that before long we are going to see many pleasure boats fitted out with Diesel motors, especially as they are so economical in comparison to other power.

Fuel oil consumed per hour amounted to 22 gallons at an average speed of 10.5 knots or about 2 gallons per mile. During this cruise there was a great difference in the amount of lubricating oils used, due to the difference in climatic conditions, sometimes being as low as 3 gallons per day and at other times 8 gallons per day when it was especially hot in the tropics. Valves were ground first every 10,000 miles. As they were usually found in good condition they are now only ground every 20,000 miles, a figure which speaks for itself. Best results were obtained with a 24-26 degree Baume fuel oil which, however, was not obtainable at all ports where the OHIO stopped for fuel.

To say the least this was a most remarkable performance for a new yacht and is a credit to American industry. It is simply a matter of time before the value of Diesel engines will be appreciated and the economical value of this type of engine universally recognized.

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Standard Specifications for Oil Engine Fuels

Compilation of Replies to a Communication Addressed by MOTORSHIP *to Representatives of the Marine and Stationary Oil Engine Industry, to Users of Engines, and Oil Companies on the Possibility of Recommending Uniform Specifications for Oil Engine Fuels*

RECENTLY we addressed a communication to a selected group of our readers asking them to give what they considered to be the most suitable approximate specifications of petroleum oil for use as fuel in the various types of heavy-oil engines. We felt that this was a subject of importance to the entire oil-engine industry and undertook this work with a view to furthering the interests of all concerned in it. The maintenance of certain standards in the supplying of fuel for oil-engine consumption appeared to offer many advantages, such as:

Better and more uniform engine operation.

Less adjustment of mechanical parts for changes due to various fuel oils now on the market.

Cheaper fuel oil due to maximum production of a uniform grade of fuel and elimination of storage of the many varieties.

To be able to compare the performance of engines built by the various firms and having a specified fuel the results are comparative.

Giving the purchaser of oil-engines greater confidence through the fact that a uniform oil would be available giving the maximum power for the money.

Such were the considerations we advanced as a basis for discussion. That the subject is more or less interesting is indicated by the answers received and the non-response on the part of some of those addressed merely indicates that insufficient thought has been given to the question of fuels. In such cases there appears to have been an over-concentration on the perfecting of mechanical detail with a corresponding lack of attention to the primary source of power. In preparing this article there has been made a digest of the letters received in hope that the information gathered will be of assistance to other individuals and companies interested in this important question of securing the right fuels for oil-engines.

Replies to our letter which were received show an interesting condition existing among engine manufacturers. A few are directly opposed to standardization, others are noncommittal and are waiting for the initiative to be taken elsewhere. The greatest number, however, have quite definite ideas of what is needed and probably only require co-operation of a few others to start a movement that will carry the industry a step further.

Those directly opposed appear to believe that their engine will work satisfactorily on any fuel that will burn and believe that specifying certain standards would be regarded as an unfavorable comment on their engine. One or two of the replies are from discouraged owners who regret the installation of their oil-engine simply because the wrong fuel oil has given trouble. Excessive wear has caused loss of compression and power attended by a condemnation of oil-engines in general. Such statements from discontented owners do more harm than can be counteracted by the missionary work of many salesmen.

The noncommittal class or group is quite large, many frankly admitting that they are not familiar with the subject or have not as yet arrived at any definite conclusion in regard to specifying a particular range of fuel oils. Some of the members of this class did not wish to be quoted as making any definite statement on the subject, but in general all showed great interest and no doubt will be heard from once the matter begins to be actively discussed.

The remainder gave us their ideas of what they considered good fuel oil for the various types of Diesel and oil-engines. It is interesting to note that the subject has received the greatest attention from our European correspondents, and although they have achieved good results with their engines, we find only a smaller number who claim that their engines are capable of using any kind of fuel. The majority specify quite plainly with what kind of oil the best results are obtained and which are in the long run the most economical for the buyer of their engines.

All specifications received are summarized in a table given herewith, so that our readers can benefit by the information obtained in reply to our inquiries. We believe in getting all this information on the subject and discussing it with a view to

REPRESENTATIVE SPECIFICATIONS FOR OIL ENGINE FUELS

Spec. Gravity Deg Bé	Sp. Gr	AMERICAN REPLIES							U.S. GOV'T SPECIF			AMERICAN OIL COMPANY	ENGLISH REPLIES			FRENCH REPLIES		GERMAN REPLIES				Averages
20	0.933																					
21	0.927																					
22	0.921																					
23	0.915																					
24	0.909																					
25	0.903																					
26	0.897																					
27	0.892																					
28	0.886																					
29	0.881																					
30	0.875																					
31	0.870																					
32	0.864																					
33	0.859																					
34	0.854																					
35	0.848																					
36	0.845																					
Flash Pt. °F. Closed Cup				150					150	150	150	175	150	170	175					140	150	
Flash Pt. °F. Open Cup		180	150	190	150							195		195		150	150	150	185	195	150	170
Viscosity Saybolt at 100°F.		45											50						45	55		50
Viscosity Saybolt at 77° F			50								100	70							50	60	90	70
% Sulphur		0.5	1.0	1.0	2.0	0.0	0.5				1.5	0.7	1.0	1.0	3.0	2.0	2.0	2.0	0.09	0.05	2.0	1.2
% Ash			0.5	0.5		0.0					0.5			0.0		0.05	0.05		0.05		0.0	0.2
% Asphalt				0.3		0.0	6.0					0.0		8.0			5.0		0.05	0.0	0.02	2.2
% Water			0.5	0.5	0.5		0.8		0.5	1.0	0.5	0.5		0.0	0.5	1.0	1.0	1.0	0.0	0.0	1.0	0.5
B.T.U per Pound				19-000	18-500	18-500						19-290	19-400			18-000		17-8.50	18-+290	18-100		18-620
% Acid Calc. as Oleic					0.05										0.05							0.05
% Hydrogen																		12.0				12.0

Chart showing fuel-oil specifications received from many domestic and foreign oil-engine builders, users, and others concerned with supplying fuels for heavy-oil engines. They form a basis on which a standardization of fuels can be evolved

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arriving at some definite conclusions that will form basis for further study.

Before taking up some of the physical and chemical specifications listed, it may be well to recapitulate the various scales of gravity, flash point, viscosity, and the like to form a basis for the considerations which are to follow.

Beaumé is the name of the scale which is used mainly in the American petroleum industry and corresponds to the specific-gravity figure as used in European countries. Specific gravity is the weight of a volume of oil in terms of an equal volume of water at 15 degrees centigrade, which is taken as unity. Beaumé readings are of value as they help determine the quality of the oil. Those oils with a low Beaumé degree are usually viscous, tarry, and are apt to hold in suspension mechanical impurities such as sand, grit, and dirt, whereas an oil with a high Beaumé is more mobile and as there is a greater difference in the specific gravities of the oil and the impurities, greater ease of separating the two is the result. Impurities can be removed to a greater extent by settling.

Some of the Beaumé degrees recommended as suitable are confusing as they refer to a particular class of fuel oil supply and include such oils as shale oils, lignite oils, coal tar oils and those of animal and vegetable derivation. This is particularly true of the French recommendations given in the table and does not imply that a Beaumé of 20 is serviceable. As petroleum oils constitute by far the largest percentage of fuel oil in the world, this discussion is confined to them.

There is also a definite relationship between the calorific value of the fuel and the Beaumé. With a lower Beaumé are associated fewer British Thermal Units per pound of oil than in the higher Beaumé oils. This subject will be further dealt with under the calorific values of fuel.

The greatest number of replies favor oils with a Beaumé gravity of 24-32 degrees. Between these two limits the oils are safe, mobile enough for pumping, sufficiently free from suspended matter, economical from the standpoint of not causing undue wear on the engine and capable of being practically marketed by the refiners. No doubt there are engines that can run on heavier oil than this, but as indicated by the replies, the figures given are those most commonly adopted and should act as a general guide for the purchase of fuel oil. They give a very reasonable assurance that it will work well in most engines, without causing an undue rise in maintenance charges.

Flash point is a factor of importance for engine users as a precaution against explosion and fire hazards in the transportation and storing of the fuel oil. In itself it has little bearing on the quality of the oil for engine use.

The consensus of opinion is that 150 degrees Fahrenheit is absolutely safe, no doubt this is over-cautious, yet there is no need for running any hazards with a lower standard. This does not mean that the oil is required to flash at the stated temperature, but that the flash shall not be lower than 150 F. (65.5° C.) in a closed tester (generally a Pensky-Martens closed tester is used in the United States). The results obtained in an open tester are usually 20-25 degrees higher, but more accurate results are obtained from the closed tester and therefore should be adhered to.

Viscosity is the degree of fluidity referred to that of water at certain temperatures. This property of the oil is of importance in considering its value for internal-combustion engines and should be carefully studied by users of oil engines. Very viscous oils, aside from holding greater quantities of impurities in suspension, are quite generally considered to be harmful, although it would appear that a greater degree of conciseness in the statements made concerning this subject would be desirable. At the temperatures occurring in the Diesel cycle, sulphur burns to a gas known as sulphurous anhydride which is entirely without corrosive action so long as it does not come in contact with actual moisture. Water, of course, cannot exist as such in an oil-engine cylinder during normal operation and is present there only as a dry superheated gas, having no opportunity to form an acid with the sulphurous oxide. Striking proof of the non-corrosive properties of the sulphurous anhydride is furnished by its use in domestic refrigerating sets which run for years at a time and depend

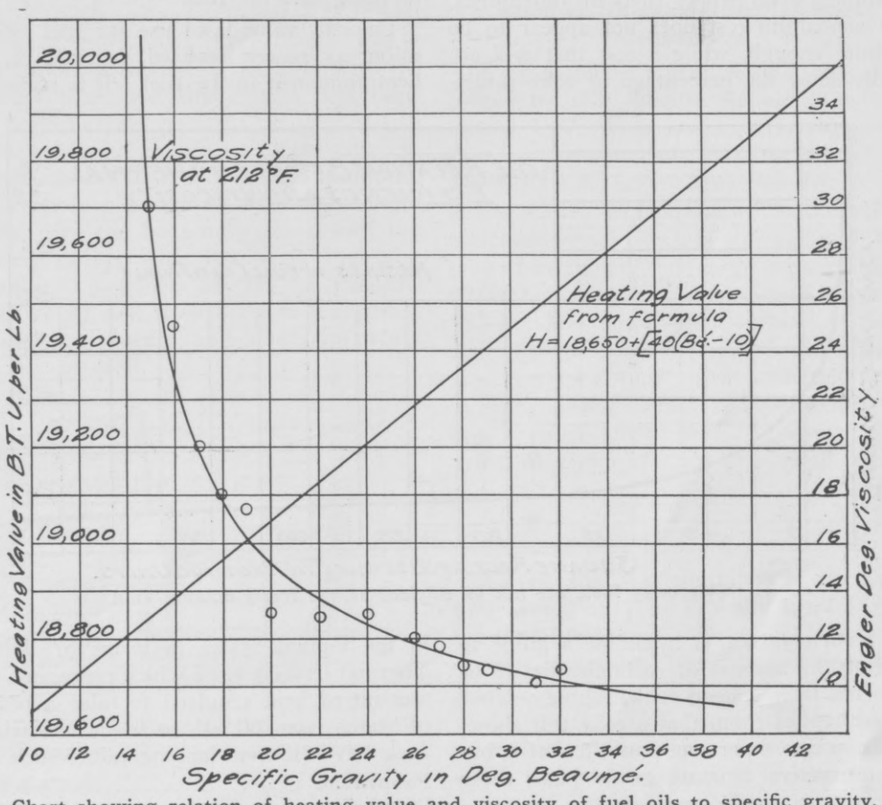

Chart showing relation of heating value and viscosity of fuel oils to specific gravity. As the latter decreases viscosity also diminishes, but heating value rises

apt to cause fouling of the moving parts, are atomized with greater difficulty than the more fluid oils and naturally take a longer time for combustion and result in a loss of efficiency. This is strikingly brought out in the graph reproduced herewith showing the relation between square root of viscosity and the thermal efficiency of a Diesel engine. It is taken from H. Moore's "Liquid Fuels for Internal-Combustion Engines."

Viscosity is also closely related to specific gravity and an additional diagram shows why very heavy oils are less apt to give good results. So far the best results have apparently been obtained with oils having a viscosity of approximately 50 seconds at 100 F. or about 66 to 77 degrees F. This seems to be within reason and corresponds closely to viscosities found in oils having a Beaumé of 24-32 at standard temperature.

Sulphur as an ingredient of fuel-oils is entirely upon the liquefied sulphur compound for their lubrication. It is only when sulphur gas meets condensed water drops either in the exhaust passages or in the engine cylinder after stopping and when the metal surfaces have begun to sweat that acidulation and corrosion occur.

According to the replies received, sulphur in amounts less than one per cent have not been found to be objectionable and it is only our German correspondents who specify fuels containing no trace of sulphur. This appears to be an unnecessary restriction which, under the conditions prevailing here, would only serve to work a hardship.

There is reason to believe that fuels rich in sulphur have caused damage not so much because of their chemical effects, but because of the fact that a high sulphur content is generally associated with high viscosity. The latter property causes fuel-oils tenaciously to retain foreign materials

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such as grit and water, which are the real destructive agents. That is why a centrifugal purifier has been found to be effective when used on high sulphur fuels. It does not effect a chemical purification of the oil in the sense of separating the sulphur from it, but what does happen is that the centrifugal process throws out the harmful foreign matter. What has already been said about the chemical action of sulphur in a normally operating engine gives a clue to the success which has attended the use of centrifugal purifiers on high-sulphur oils.

Information which has been collected does not include very much about coke residue, although it would appear that this might have considerable advantages in determining upon proper fuels for oil-engines. An asphaltum test does not appear to be definite enough, while a test that will actually show the percentage of coke resulting from combustion might be a guide to judging the amount of carbonization to be expected from a good fuel. Three or four of our replies claim that a coke test showing from 5 to 8 per cent is not harmful, but a conservative estimate would place these figures nearer to 1½ per cent.

Coke residue represents a stage of combustion close to the final one and should constitute a further index of the suitability of a given oil for engine use. Except in the bottom of the piston ring grooves, the formation of coke in an engine running under ordinary conditions is a rare occurrence, but the need for protecting piston rings makes it appear advisable that specifications for engine fuels should include a coke range. From ½ to ¾ of 1 per cent should be suitable, but considerable variations in these figures may be expected before anything like finality is reached.

Water is usually present in the heavier oils in a suspended state as the differences in specific gravities are not sufficient to allow the water to settle out. This water in suspension causes misfiring of the engine and tends to assist corrosion, especially if it is salty. Salt cakes up the exhaust valves and forms a tough incrustation productive of leakage and pitting. Nearly all the replies agree pretty well that the content of water in oil should not exceed 1 per cent and the average favors about 0.5 of 1 per cent. Doubtless an oil with such a low water content will be expensive to produce and it seems as though 1 per cent should be acceptable.

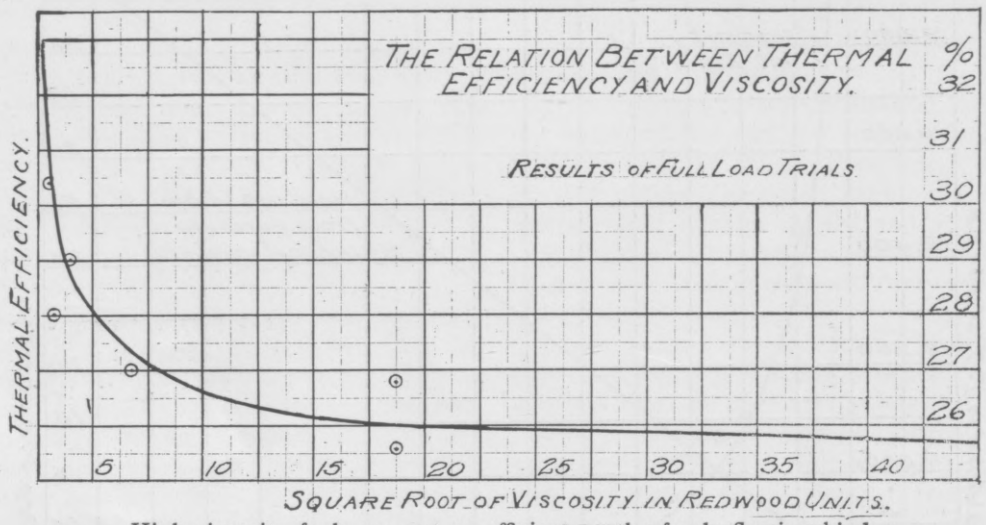
Only two replies mention the subject of acidity. Of course, at very high temperatures most acid bodies would be volatile and be decomposed rapidly, however, traces of acid in an engine still warm after shutting down will cause corrosion of the parts. We know that lubricating oils are watched very carefully as to acid content, while little attention so far has been paid to this item in fuel oils. .05 of 1 per cent calculated as oleic acid is the limit set by our two replies and is one that we would advise as being safe for fuel.

Calorific value is of use for fuel estimation, as power realized depends on the heat contained in the fuel. It is measured in the United States in terms of British Thermal Units, one of which represents the amount of heat required to raise a pound of water from 60° F. to 61° F. Various fuels have different heating values such as:

Pennsylvania Coal	14,175 B.T.U.
Illinois Coal	12,700 B.T.U.
Pine Wood	7,960 B.T.U.
American Diesel Fuel Oil, 24° Bé.	19,200 B.T.U.
Boiler Fuel, 14° Bé.	18,800 B.T.U.
Coal Tar	15,600 B.T.U.

As stated, there is a relationship between calorific value and specific gravity of a quite uniform nature capable of being formulated thus: Gross B.T.U. = 18,650 — [40 (Beaumé — 10)]. A change is made in the value of the figure 18,650 for the various kinds of oils. This is plotted on the diagram with results which check up closely with results obtained by calorific determinations with a bomb calorimeter.

Net B.T.U. are approximately 900-1,000 B.T.U. lower than the gross figure due to the fact that in the calorimeter the oxygen and the hydrogen of the oil combine to form water whereas in an engine the water escapes in the form of vapor. A correction is therefore necessary for the latent heat of the condensing water, depending on the percentage of hydrogen present in the fuel. A good fuel should have 18,600 net B.T.U., the average recorded by our replies, but as this is rather a difficult stipulation, it might be suggested that the specification should be 18,300-18,900 net B.T.U. per pound of oil. Sometimes better results in thermal efficiency are obtained from an oil of lower heating value, say 18,700, than another of 19,000. This is explained by the fact that the oil with 18,700 has a Beaumé gravity of 11 while that of 19,000 measures 18.8 corresponding to a specific gravity of .993 and .941 respectively. If the oil was measured by volume, as is done on ships, and not weighed, the oil with the lower Beaumé or greater specific gravity had the greater weight and hence had more heat units per gallon.



High-viscosity fuels are not as efficient as the freely-flowing kind

On reviewing the subject it appears that the general consensus of replies received can be represented by the following standard specification:

24-32 degrees Beaumé at standard temperature.
Flashpoint—Not to be below 150 degrees Fahrenheit. (Closed cup.)
Viscosity—50 seconds at 100 degrees Fahrenheit, by Saybolt Universal Viscosimeter for 60 cubic centimeters of oil.
Sulphur—1% not to exceed 1½%.
Ash—Not to exceed 1/10 of 1%.
Water—Not to exceed 1%.
B.T.U.—18,100-18,600 net B.T.U. per pound.
Acidity—Not to exceed .05 of 1% calculated as oleic acid.

Without claiming anything like finality for the results here set forth, it is gratifying to be able to submit them in the confidence that the main object of our efforts to bring about a certain degree of standardization in the specification of oil-engine fuels has thus been made sufficiently concrete to serve as a basis of practical value. Thanks are due to the large number of oil-engine manufacturers, users, and oil industrialists who have heartily cooperated with this journal in its striving to put in a clear light the question of fuel oil specifications.

New Dutch Submarine

M.A.N. Diesel engines of 1,200-b.h.p. each are being installed in the Dutch Navy submarine K. XI, a twin-screw craft intended for service in the Dutch East Indies just launched at the Feyenoord shipyard at Rotterdam. It displaces 821 metric tons and has a length of 218 ft.

The Secret Is Out

French naval engineers have just accomplished the remarkable feat of taking apart two German submarine Diesel engines of 530 h.p. without the simplest blue-print guide, all the plans apparently having been destroyed by the Germans. So runs a story in the New York daily press. Evidently the New York daily newspapers are not aware that several years ago German submarine Diesel engines of more than twice this power were constructed in the New York Navy Yard following careful measurements of every single part.

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Oil-Engined Police Boat

A NEW field for the application of heavy oil engines has been opened up by the building of the latest police boat for the Department of Public Safety of the Commonwealth of Massachusetts. She is powered with a Bessemer Diesel engine of 230 b.h.p. and was designed by Gordon Munroe.

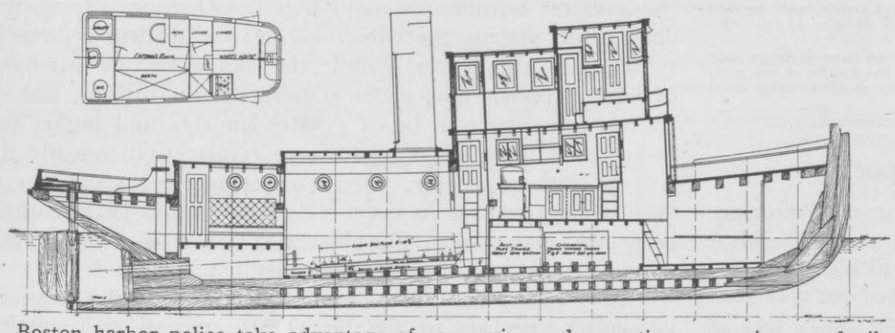
New uses for oil engined boats are constantly being discovered and for police work the notable advantage inherent in this type of craft are bound to stand out prominently. Economy in the use of fuel is important for harbor police work from the point of view of keeping down operating expenses, but the increase in radius of action and independence of local fuel supply stations are even more vital factors.

General police work on Massachusetts bay will be done by the vessel illustrated herewith. Derelicts will have to be towed, and menaces to navigation dynamited, in addition to the regular operations of libeling ships or moving them about in accordance with court orders. In the winter, rivers and canals will be kept clear of ice by the sturdy little boat.

She is heavily built with a double-sawed oak frame. For the planking, oak and yellow pine are used and a fir deck has been laid. Four steel bulkheads give the vessel a high degree of safety. She was built by Arthur D. Story of Essex, Mass., and was launched in the latter part of April. Particulars of the hull are as follows:

Length over all	72 ft. 0 in.
Length on waterline	65 ft. 9 in.
Beam over guards	18 ft. 2 in.
Beam moulded	16 ft, 6 in.
Draft	6 ft. 10 in.
Fuel capacity	1,200 gallons
Fresh water capacity	500 gallons

Since the engine consumes 15 gallons of fuel oil per hour while running at full speed, it is evident that the fuel storage tank of 1,200 gallons will carry it for 80 hours, or more than three days. For a boat intended for use in harbors with intermittent service, this means that fueling would rarely have to be attended to oftener than once a week. A gasoline engine of 230 b.h.p. would be hard to obtain, would probably not be as reliable, and would give the boat only about half the crusing radius with the same fuel-tank capacity. Needless to say, a gasoline plant would cost from three to four times as much to operate, and would involve a fire risk as well.



Boston harbor police take advantage of economies and operating conveniences of oil engine. This shows their 72-footer, which will have a 230-b.h.p. Diesel engine

4,000 B.H.P. Engines in M/S "P. C. Hooft"

Additional particulars have just been received about the Dutch ship, P. C. Hooft, which is building at the Ateliers & Chantiers de la Loire to the order of the Netherland Steamship Co. and in which very large Sulzer two-cycle engines will be installed. This is the ship mentioned in February Motorship, whose allotment to a French concern was so widely criticised by Dutch shipping interests. It has the following particulars:

Displacement (loaded)	21,200 tons
Capacity of fuel-bunkers, including double bottoms	2,100 tons
Shaft horsepower	8,000
Indicated horsepower	11,000
Engine speed	100 r.p.m.
"Ship's trial speed (expected)	15.5 knots
Daily fuel consumption	37 tons
Daily lubricating oil consumption	45 imp. gallons
Bore and stroke	26.77"x47.24"
Weight of main engines, with thrust-block and flywheel, but without propeller and shafting	820 tons
Weight of complete engine-room machinery with propeller, shafting and auxiliaries	1,390 tons
Length of machinery space	20 meters
Length o.a.	540'
Length b.p.	520'
Breadth, moulded	67' 6"
Depth moulded	38' 6"
Mean loaded draught	28' 0"

This ship will be among the highest powered motor-vessels afloat, and will be fully described in these pages with illustrations and drawings as they are made available to us.

Oil-Engined Electric Tug Launched

One of the first oil-electric tug boats in the world, the Van Dyke I, was launched June 7th by the Staten Island Shipbuilding Company, Staten Island, N. Y. This is the first one of three oil engine-electric driven tug boats, building for the Atlantic Refining Company of Philadelphia. Each tug boat is equipped with two Ingersoll-Rand Price-Rathbun oil engines direct-connected to General Electric generators, and is driven by a General Electric motor. A notable extension of the advantages of the electric drive are expected for this vessel because a number of the oil barges which it is to serve will be equipped with electric cargo pumps. Instead of the customary uneconomical method of putting a steam hose aboard a barge for running notoriously wasteful steam duplex pumps, an electric cable will now be run from the barge to the switchboard in the tug's engine room.

Another Shipping Board Vessel Conversion

A steam-driven tanker of 7,570 tons d.w. owned by the Atlantic Refining Co. and named J. W. Van Dyke, after the president of the company, is to be converted. She will be the largest Diesel-electric driven tanker afloat. In fact, she will be the largest merchant vessel which is powered with this type of machinery, her cargo capacity being 60,000 bbls. and she has an overall length of 385 ft. Her power plant consists of three Ingersoll-Rand oil-engines of the airless-injection type each direct-connected to a Westinghouse generator furnishing current for a single-screw Westinghouse double-armature motor of 2,300 s.h.p. at 100 r.p.m.

Death of Lord Pirrie

A great loss was sustained by the shipping world on June 7, when Lord Pirrie, head of Harland & Wolff, died suddenly on the steamship Ebro, bound for New York. Although 77 years old at the time of his death, Lord Pirrie had continued as active guiding force of his great firm up to the very moment of his death, and some of the most notable advances in the art of shipbuilding made at the Belfast plant are due to him.

Lord Pirrie—who was one of our first subscribers—took a lively interest in motorships, and his firm was among the earliest to acquire a license for the construction of Diesel engines. The fleet of motor vessels which has since then been launched from the ways at Belfast and Glasgow, constitutes an imposing testimonial to the workmanship of Harland & Wolff, and to the genius of their deceased leader.

High-Powered Italian Submarine

Following the successful trials of the twin-cylinder thousand b.h.p. unit of a submarine Diesel engine at the Fiat Works, Turin, the Royal Italian Navy has placed an order with this company for a pair of two-cycle Diesel engines together developing 9,000 b.h.p.

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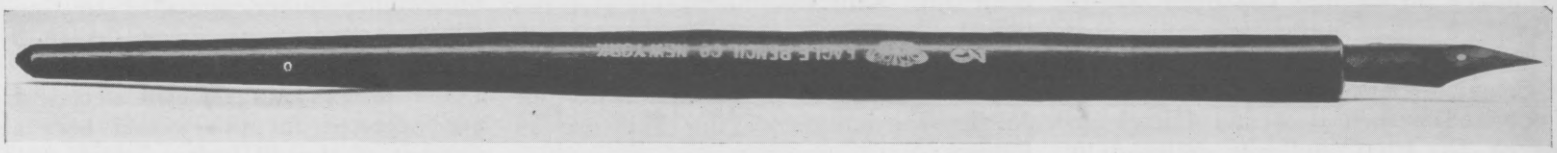
Sixty-Six Million Dollars *for* American Motorships *by a* Stroke *of* This Pen



Marking the successful termination of a long battle to modernize the Shipping Board fleet by oil engines, this pen, used by PRESIDENT COOLIDGE in signing the Conversion-to-motorships Bill, has been presented to the publication MOTORSHIP. As the humble instrument with which a new chapter in the rebirth of the American Merchant Marine was opened, it will be fittingly preserved.

Motorship

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At the Threshold of a New Epoch

THE cornerstone of a solid foundation for the American Merchant Marine was laid on June 6th, when President Coolidge signed the bill making immediately available a fund of $66,000,000 to be used in transforming the best of our war-built steamers into modern motorships by the Shipping Board and by private shipowners of this country.

The gracious act of the President in presenting to the Publishers of MOTORSHIP the pen with which he signed this act marks the successful culmination of an unrelenting fight which this journal has waged for years against apathy, conservatism, ignorance, prejudice and self interest.

Years have been wasted in theorizing, debating, abstract engineering discussions and the pursuit of bizarre novelties while the foundries and shipyards of Europe have hummed with new motorships in the making. If this precious long time is to be recovered there must be prompt decisive action on the part of the Shipping Board which should formulate and define its policies at the earliest possible date in an unmistakably clear manner defining the terms under which the benefits of the act may be enjoyed. It is to be hoped that red tape will be cut through and simple direct methods devised which will facilitate prompt action and at the same time protect the public interest.

Shipowners should be likewise on the alert in acquainting themselves with what the Board has to offer in the way of ships, plans, and assistance in ascertaining where profitable business opportunities exist for the employment of economical vessels of this character.

The Shipping Board expects to proceed forthwith to convert twelve 8,800 and 9,400 ton steamers to Diesel power, representing the first group of a fleet of some 60 vessels aggregating 600,000 d. w. tons which the Board has been authorized to convert itself, using $25,000,000 of the fund. These vessels will presumably serve as models for the private conversions which are expected to be made by individual shipowners out of the $41,000,000 balance which now comprises the loan fund. The Board has ruled that all American yards may bid. Diesel engines for ships converted under this fund must be constructed in the U. S. A., says Admiral Benson.

This stride forward is followed by the announcement that the Board proposes, with the expected sanction of Congress, to lay down at the cost of about $30,000,000 two new transatlantic motor liners of greater tonnage and higher power than any yet commenced in Europe. They will be of about 28,000 gross tons and 20 knots speed. If built at once they will represent the greatest advance in motorship construction attempted to date. But, placing the Diesel engines on quadruple propeller-shafts puts the power within the range of the machinery of similar vessels now under construction in Europe, and still enables the vessels to be of greater tonnage and higher total power than those of our commerce rivals. Consequently they will be without a peer. From an engineering standpoint the vessels are practical in every way and should be remarkably economical in operation. The absence of smoke, smell and vibration should always insure a full passenger list.

This proposal has appealed strongly to the daily press, and influential members of the House Appropriations Committee as well as the Senate Committee of Finance have approved of the plan. Readers of the *Congressional Record* will observe that Congress has recently become not only deeply impressed by, but even enthusiastic over the benefits of Diesel engines for our ships.

The Board has now definitely turned its back on the follies and mistakes which sprung from the emergencies of the war. For the first time it has started to put into effect a program which should place our merchant marine in an unassailable position if quickly carried out, especially if private shipping concerns take full advantage of the money now available to modernize their existing fleets.

We stand at the threshold of a new epoch. The funds, the shipyards, the hulls, the engines and electrical deck machinery are all available, and the costs are being brought down to a point where the finished motorship will be produced at the lowest price in the history of its developments.

Discussing the proposed Diesel lines the New York *Tribune* points out that, "for a sound merchant marine we cannot stand on the ships we have; we must build newer and more economical ones and keep our dying shipyards at work. This is a critical juncture in our future on the seas, and if ever there is a time for doing what we imagine the war had done, it should be in the course of the next two or three years. That is why the Board is talking Diesel engines."

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"Silverelm" Has New Model Opposed-Piston Engine

Only Three Cylinders Are Used and Scavenging Pump Is Driven Off the Beam; Engine Room Is Short Although Two Auxiliary Boilers Are Placed in It; Purifiers and Pyrometer Enhance Good Running

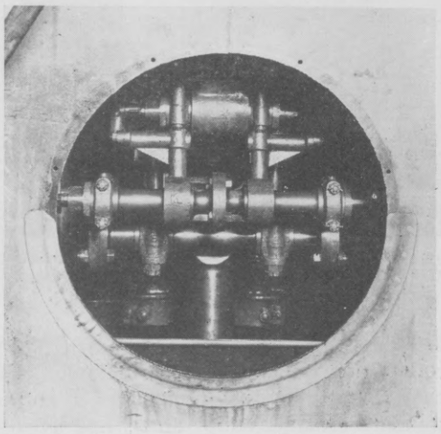
ARRIVING in Baltimore after a successful maiden voyage from England, the new motorship SILVERELM picked up a cargo at that port and arrived in New York on June 8. She is the first of the Roosevelt motorship fleet which is to be placed in a round-the-world service jointly with the Kerr Line, and as was announced in the June issue, is shortly to be followed by the SILVERCEDAR, SILVEROAK, SILVERLARCH, SILVERPINE and SILVERFIR. These vessels are to initiate the motor shipping policy now actively undertaken by the Kerr-Roosevelt interests, and their successful operation, we are informed, will be followed up with the commissioning of additional motorships built and equipped entirely in American yards.

As at present planned, the following itinerary will be followed by the SILVERELM after leaving New York on June 18:

Newport News,
Panama,
San Pedro,
Yokohama,
Shanghai,
Ilo Ilo (Philippines).

During her stay in New York the SILVERELM was thrown open to inspection by Kermit Roosevelt, who entertained a number of representative shipping men at several luncheons held on board her. The cordial manner in which the visitors were received was thoroughly appreciated and great interest was shown in the noteworthy features of the vessels. Captain Griffiths assisted in entertaining the visitors and Chief Engineer Stephenson conducted a series of highly interesting engine-room inspections.

One of the more novel features which were exhibited is the "duct keel." Running between the forward end of the engine room and the after end of No. 1 hold, it provides a space for all the bilge and tank piping. According to the plans generally followed in the past, these pipes are led along the bilge-well on the port and starboard sides of the holds next to the double bottoms. Not only are these pipes entirely inaccessible at all times when there is cargo in the holds, but in the event of a break it may become impossible to pump bilges or to prevent the contents of one of the tanks from being dumped into the cargo space. By placing these pipes in the duct keel, cargoes are protected against damage and defective joints, and other troubles can be detected at once and remedied.



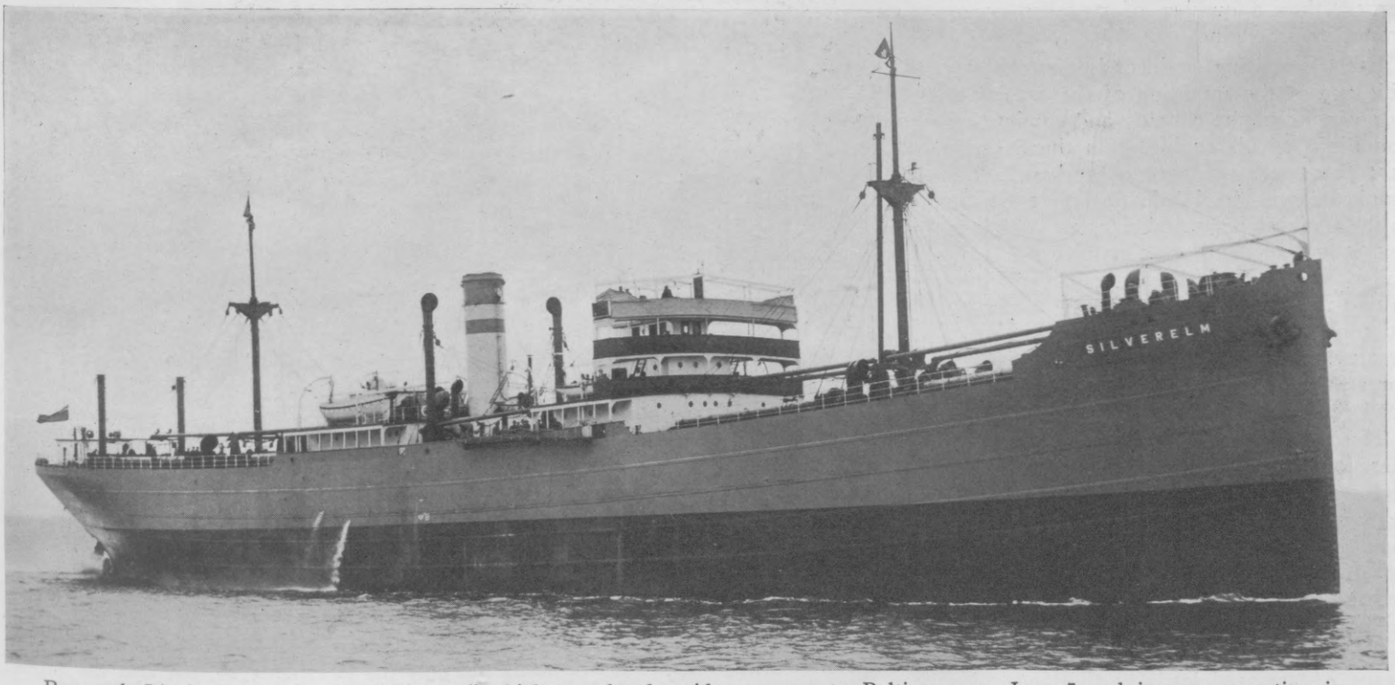
Cooling gear for lower piston of Doxford oil engine

The duct keel opens out into the cofferdam of the engine room and extends 18 inches to each side of the centerline of the ship. Since it is of the same height as the double bottom, it affords ample room for the accommodation of the piping and at the same time leaves enough space for an engineer to pass and to work at the joints.

Propelling power is furnished by a Doxford 3-cylinder, 6-piston, 2-cycle engine developing 1,850 b.h.p. at 85 r.p.m. Although the throw of the crankshaft is only 21¼ inches, the combined motion of the opposed pistons, characteristic of the Junkers-Doxford design, amounts to 85 inches. The cylinder bore is also 21¼ inches. In contrast to the Doxford designs which have hitherto been generally known, the SILVERELM's engine has only a single set of A-frames astride of each main bearing, and the scavenging pump is driven off the beam. Both of these features have effected a pronounced shortening of the engine, which has been accommodated in an engine-room of remarkably small dimensions.

Beams for driving the scavenging pump also provide convenient and accessible means for actuating all the various pumps which are necessary at sea, an arrangement which makes this an entirely self-contained unit. It will be recalled that the preceding models had a bulky scavenging pump located in the center between two groups, consisting of two working cylinders each. The compactness, rigidity, and ease of supervision prominent in the design under consideration occupied a large share of the visitors' attention and was favorably commented on by them.

Upon being accorded the privilege of climbing inside the engine, we were struck with the simplicity and accessibility of all the moving parts. Crossheads and guides for the bottom pistons are mounted in the



Roosevelt Line's new motorship "Silverelm" which completed maiden voyage to Baltimore on June 7 and is now operating in round-the-world service

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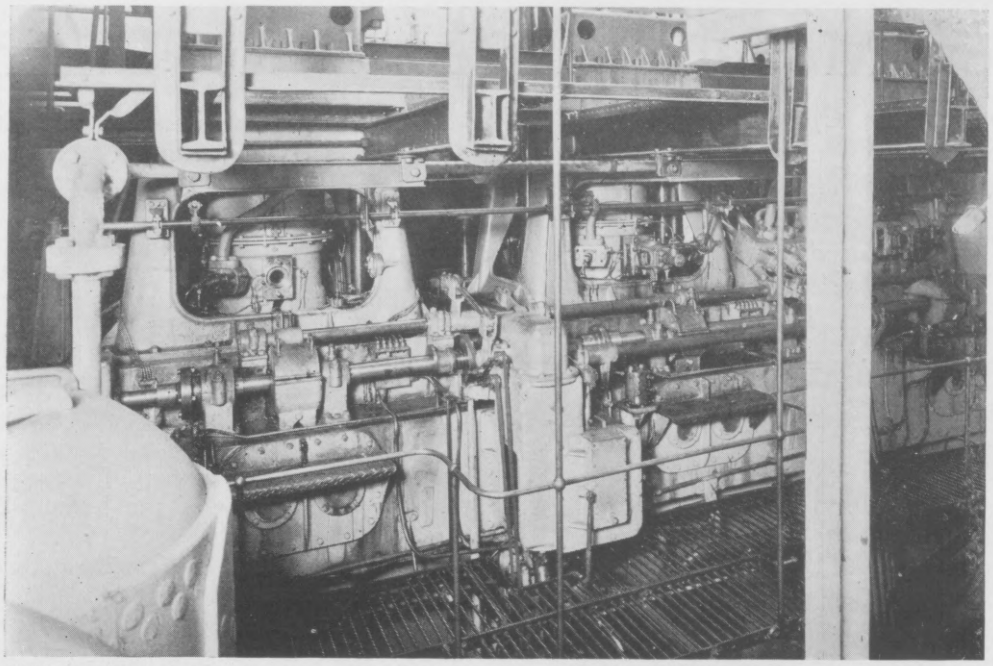


"Silverelm's" 3-cylinder opposed-piston engine. After a 3,000-mile voyage only one fuel-valve was removed (cylinder at left) and a little carbon taken out of one of its six spray holes

usual manner at the back of the framing, whereas the two outer crossheads for the side rods hang down from the upper part of the crankcase like the guides for valve-rods frequently found on the under side of steam engine cylinders. There is plenty of room around them and the operations connected with keying up on them are no different from what must be done in steam engines. Whereas the central crosshead for the bottom piston is normal in every respect, the two outer ones work under decidedly easier conditions. Because of their high location, the connecting rods are long in relation to the crank arm, with the result that the crossheads are called upon merely to steady them rather than to take any appreciable thrusts from them. It was apparent from our inspection of the crankcase interior that the conditions of working in it are actually more comfortable, at least as far as the various crossheads are concerned, than a number of so-called open-frame steam engines.

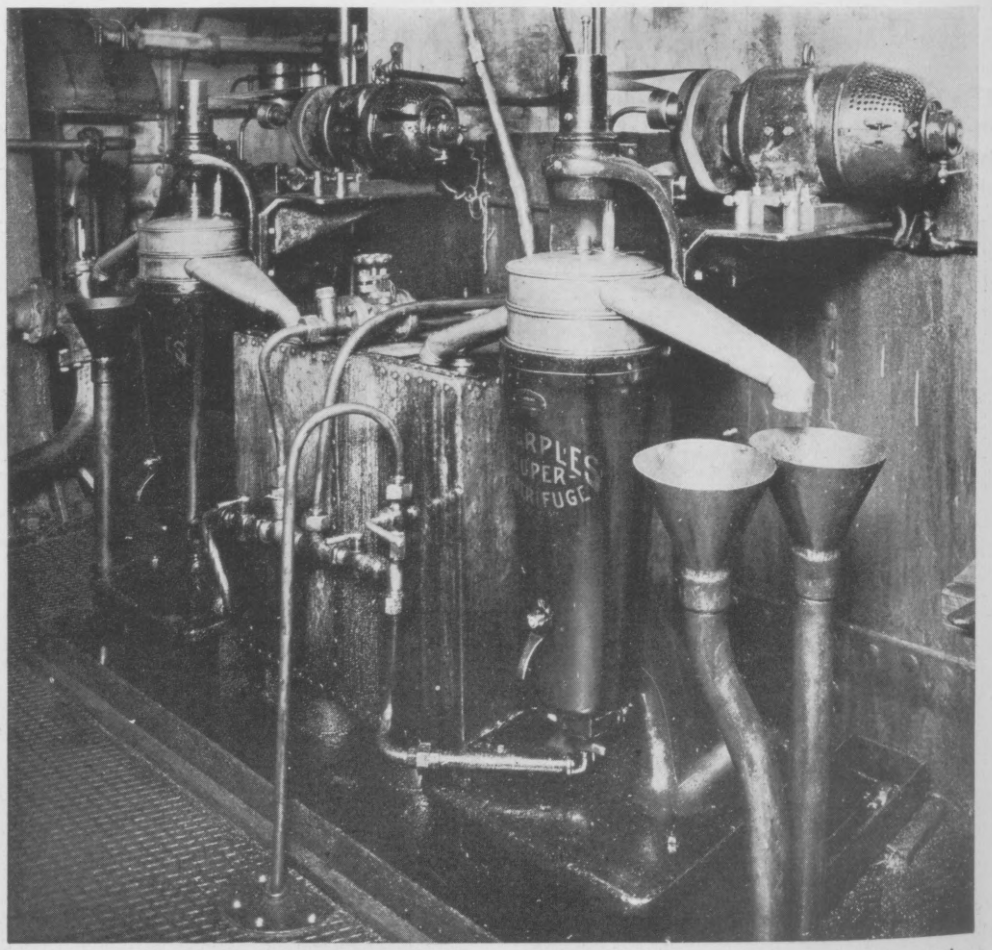
Every operating engineer knows the significance of the condition of the crankcase as an index of the running and combustion conditions of his engine. On the SILVERELM there was no trace of carbon in the crankcase and the lubricating oil adhering to the working parts and sides was so clean that it left no discoloring stains on a fresh boiler-suit. It must be borne in mind that in two-cycle engines there is no way of partitioning off the cylinder from the crankcase because of the long trunk piston necessary for sealing off the inlet ports at the firing dead center.

The excellent combustion attested by these observations are attributable to correctness in the design of the fuel-injection gear, to good operating discipline, and to the use of subsidiary apparatus for the control of combustion and for the conditioning both of the fuel and of the lubricating oil.

Fitted on the entablature of the engine is a Siemens electric pyrometer attached by means of armored leads to thermocouples located in front of the exhaust ports. When combustion is proceeding at maximum efficiency, this instrument indicates a normal standard exhaust temperature, and as soon as any tendency towards misadjustment or improper conditions begins to arise, a higher reading will be observed. Combustion in the cylinder normally has been completed at about 1/10 of the stroke and after that the gases are progressively cooled as their heat content is converted into mechanical work on the piston. Should a spray valve clog, or should anything else cause imperfect burning during that part of the stroke which ought to be devoted to expansion, the mean temperature of the process is at once raised and shows up promptly on the pyrometer. Carbon is formed, rings become stuck, if the warning is not heeded, or if, in the absence of a pyrometer, the engineer must depend upon his senses assisted by roundabout checking methods to tell him that something is amiss. An engine may run with improper combustion conditions for a considerable period of time before they manifest themselves by fouling up the crankcase or by thrusting themselves on the engineer's attention in other ways.

There is one source of imperfect combustion which has been effectively blocked on the SILVERELM, and that is dirt and water in the fuel oil. Two Sharples centrifuges are continuously on duty for the purpose of removing foreign matter both from the lubricating and fuel oil. The latter is particularly apt to pick up water and tank dirt, as the result of which fuel-injectors are likely to be disturbed in their operation. In a cylinder thus affected, fuel burns late in the stroke, produces carbon and high temperatures, and results in the generally undesirable running conditions already referred to.

No amount of care in the operation of ships will insure keeping salt water out of a force-feed lubricating system, and that fact alone would justify the use of a centrifugal purifier on the lubricating oil. Vacuum Co. D. T. E. extra heavy oil was used on the SILVERELM for the fresh-oil supply to the cylinders, whereas the heavy medium grade was used for the force feed system. By keeping this oil free from



These centrifuges continuously purify not only the lubricating oil, but also the entire supply of fuel used by the engine

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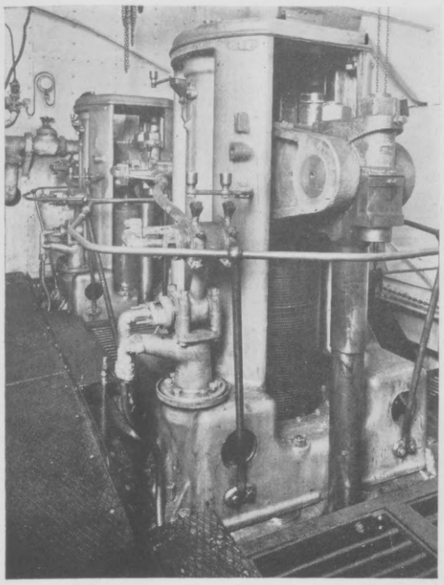


Upper piston and cooling gear. Tool-marks are still visible on piston after 3,000-mile voyage

water and tank-scale, the purifiers enabled it to give the engine the full benefit of its high lubricating value. A striking commentary on this was the condition of the surface of the upper pistons which were visible. All the tool-marks were still plainly visible on them and their appearance suggester an initial test-run rather than a 3,000-mile voyage in the Atlantic.

Steam auxiliaries are used all over this ship both for the engine room and decks, a practice in favor of which a certain number of arguments may be advanced. Even the spare fuel-injection pump is steam driven and is capable of being thrown into action at a moment's notice. Bilge-pumps, sanitary-pumps, transfer pumps and every other conceivable kind of apparatus has its lagged steam and exhaust piping and gives the engine-room that characteristic appearance associated with steam vessels. It is an interesting commentary on the space taken up by the oil engine that the two auxiliary boilers are accommodated within the limits of the engine room proper. They have dome-shaped combustion spaces, which, although furnishing an ample and efficient combustion volume, cause the gauge glass to be located at a considerable elevation.

Particulars of the SILVERELM are as follows:

Length	375 ft. 0 in.
Breadth	52 ft. 6 in.
Depth	28 ft. 4 in.
Draft	25 ft. 1 in.
Deadweight capacity	8,075 tons
Daily fuel consumption	7.8 tons
Daily lubr. oil consumption	14.3 gals.

For the present this ship will be operated jointly by the Kerr-Roosevelt interests and Stanley & John Thompson, Ltd., and will sail in the round-the-world trade. Exact details as to the part which each of the various firms will have in the operation of the SILVERELM and the other vessels of the series has not, as yet, been made public, but it is our understanding that as the Kerr-Roosevelt interests succeed in building up this business, they will put their operations on an all-American basis.

The SILVERPINE'S Engine

Reproduced herewith is a three-quarter view of the Swan, Hunter & Wigham Richardson engine installed in the Roosevelt Steamship Company's motor vessel SILVERPINE, which was lauched on May 3 and referred to on page 429 of June MOTORSHIP. She is of the shelter-deck cruiser-stern type with three masts and has the following particulars:

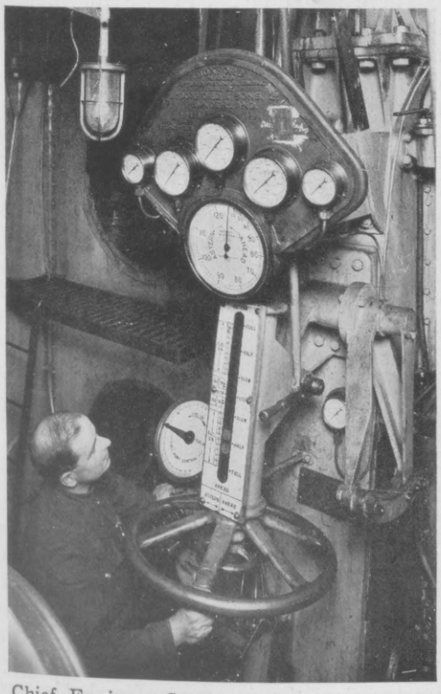
Length, b. p.	400 ft.
Breadth, moulded	55 ft. 3 in.
Depth	28 ft. 8 in.
Deadweight	8,400 tons.

A complete description of an engine of the same model as that which is being installed in this ship was also published in our May issue. This is the "Neptune" B Type with scavenging pumps driven off the beam and expansible combustion-space sleeves in the cylinder heads. Although the cracking of heads and liners of oil engines has now become so rare as to be negligible, particular care has been taken in the design under consideration to reduce such occurrences even further. As will be apparent from reading the article above referred to, considerable ingenuity is displayed in the construction, in which the purposes sought after have been accomplished in a strikingly simple manner.

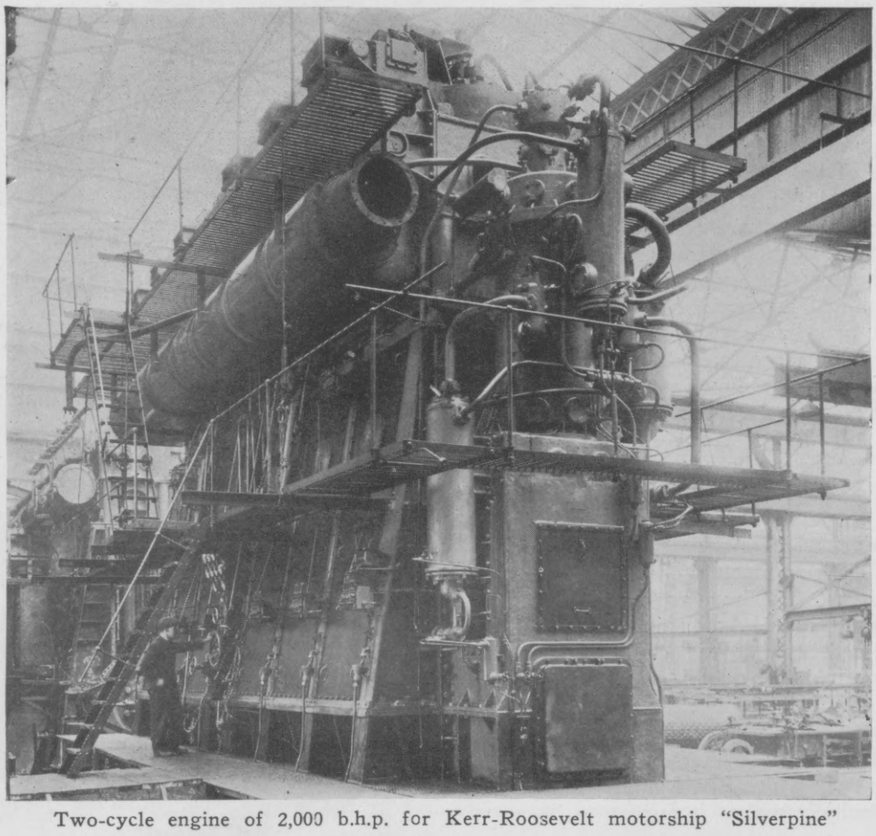
The SILVERPINE's engine illustrated above develops 2,000-b.h.p. in six cylinders at 100-r.p.m. Stroke and bore dimensions are 45x22½ inches and the entire weight is only 242 tons.

Death of Dr. Otto Alt

It is with keen regret that we record the death of Dr. Otto Alt, chief engineer of Krupp's Germaniawerft, department of Diesel engine construction. He is known to the readers of MOTORSHIP because of his varied and interesting articles of a technical nature dealing with Diesel engines. He had been a passenger of Diesel tanker PROMETHEUS, on the return voyage of which he became subject to the illness to which he succumbed shortly after landing. He was only 41 years of age and his demise will be keenly felt.



Chief Engineer Stephenson at the throttle of the "Silverelm"



Two-cycle engine of 2,000 b.h.p. for Kerr-Roosevelt motorship "Silverpine"

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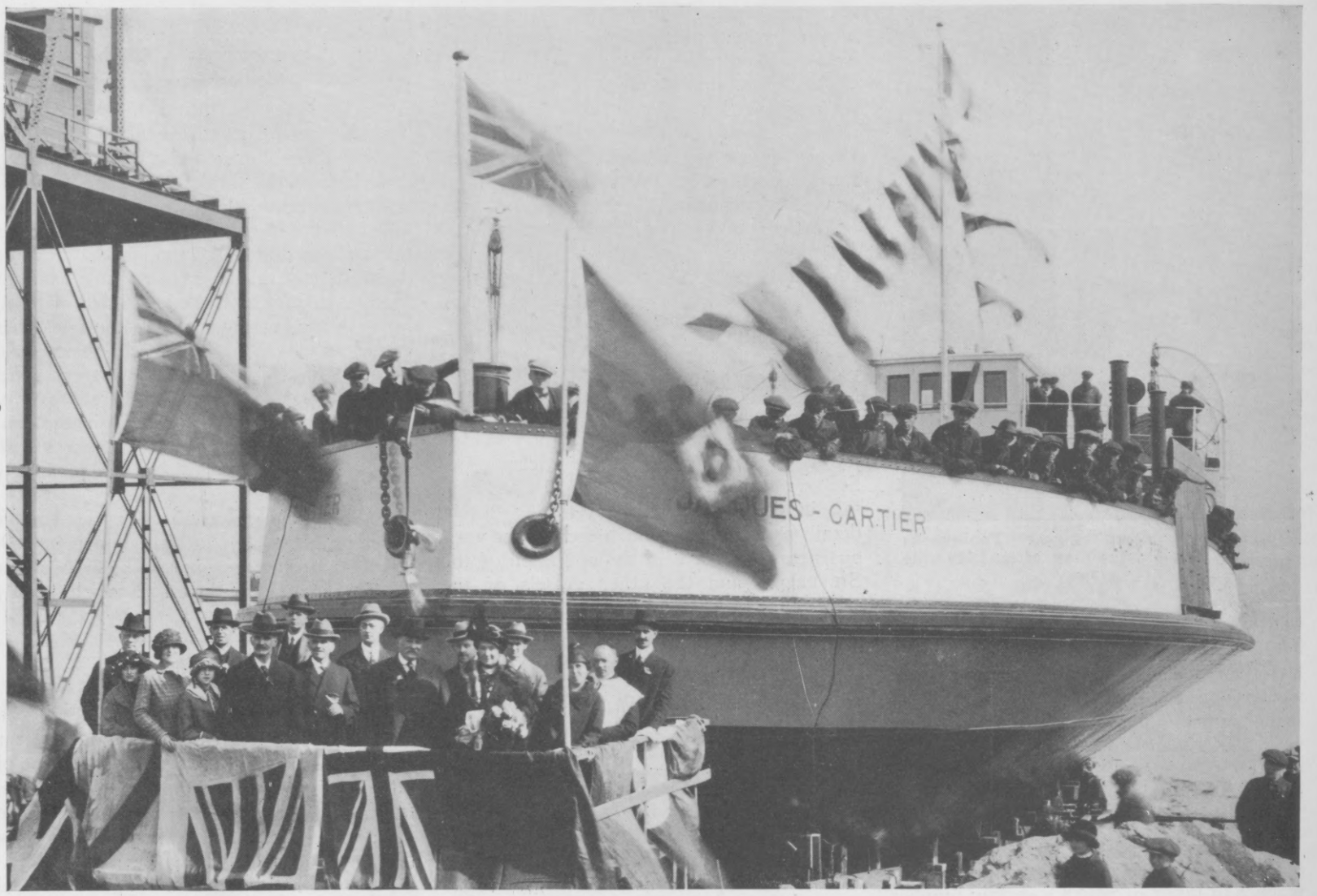

Launch of 35-car automobile ferry to run between Caughnawaga and Lachine, a crossing frequented by automobilists

35-Car Automobile Ferry for $45,000

The Lachine Ferry Co., Ltd., Operating Between Caughnawaga and Lachine, Adds Oil Engined Craft to its Fleet. A Serviceable Boat Accommodating 35 Cars Assists in Carrying International Automobile Traffic

ATTENTION was drawn in an article in our previous issue to the rapidly growing importance of oil-engined ferries which are being urgently demanded to handle automobile transportation across rivers and streams. Manufacturers of this type of vessel and oil-engine builders will undoubtedly find valuable opportunities for an extension of their activities which will be afforded in this expanding field. Phenomenal among American industries, the manufacture of automobiles continues to eclipse all others by its sensational growth and a chance to share in some of the benefits resulting from it should make a strong appeal to builders of oil-engined vessels suitable for still further increasing the application of the automobile.

That the construction of oil-engined ferries for automobile transportation has attractive business and technical possibilities is well brought out in this article, for the material of which we are indebted to Walter Lambert, Naval Architect of Montreal, who designed, constructed and supervised the oil-engined automobile ferry herein described. An engineer, according to some definitions, is nothing more than a scientifically trained business man, and the able manner in which Mr. Lambert has handled this subject makes it appear to be an entirely correct one. Good business and sound engineering always go hand in hand.

The attached plans and photographs might be said to represent an answer to the question—"How to build a steel 35 auto ferry for under $45,000?"—for that was virtually the problem set the designer. If this figure were to be exceeded, and in fact owners had considered it impossible not to, then a second-hand vessel would be the only solution to their problem.

Finishing touches being put on the "Jacques Cartier"

There might be an excuse for thinking that such a condition would inevitably mean a scamped job, but while there are no frills or unnecessary equipment on the motor ferry JACQUES CARTIER, it is essentially a strong and serviceable vessel, built to Bureau Veritas highest class for the service intended.

An auto-ferry, like other types of vessels, has its own problems—abnormally large deck area is an essential, but this tends to a wide, flat, uneconomical driving hull, which tendency is sometimes obviated by building sponsons outside a normal hull, or even by a catamaran type of design. In the JACQUES CARTIER a rather novel solution is offered to this problem, which to a large degree meets the requirements for low cost.

Examination of the plans will show that there is a small area of flat bottom, the remainder of the hull surface being entirely flat in a transverse direction, and angled to the same degree of inclination fore and aft. Consequently, every frame in the ship is straight and the only furnaced plates are the boss plates; in order to further simplify construction, the fore and after bodies are exactly alike. The great advantage of this

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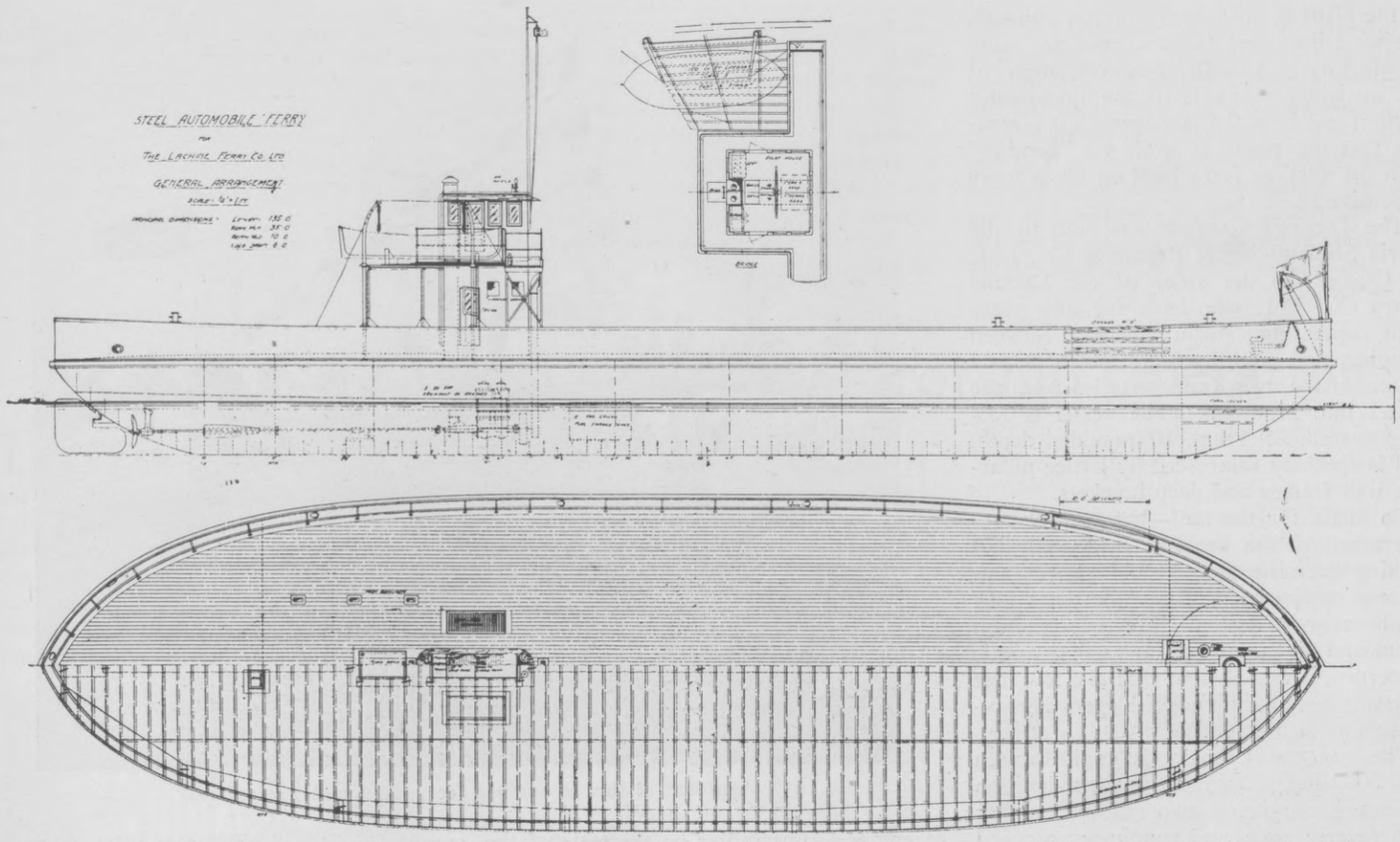
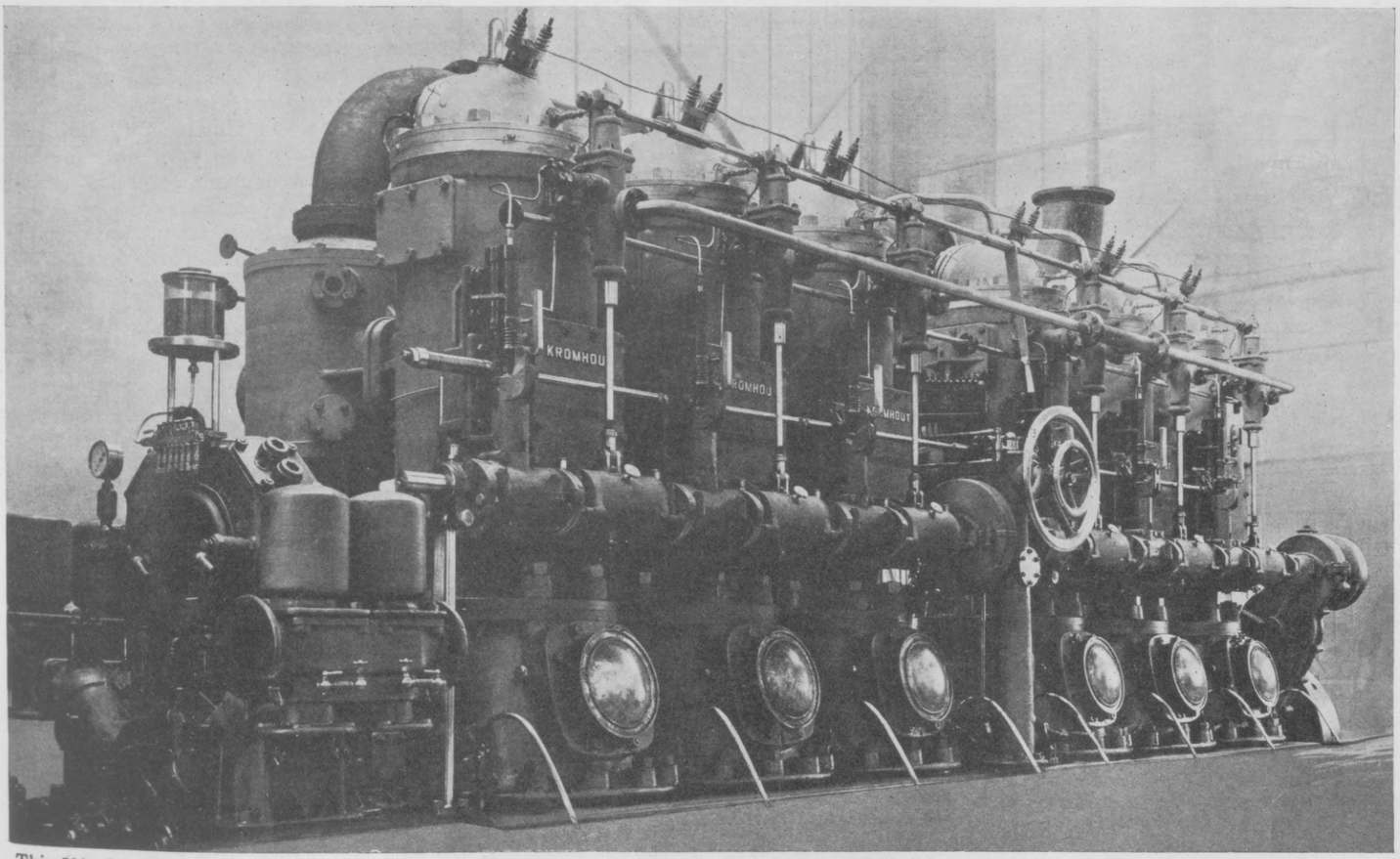


Large deck-surface for the accommodation of automobiles is a feature of this oil-engined ferry. Pilot-house control for her twin 80-b.h.p. surface ignition engines enables the "Jacques Cartier" to be easily steered and maneuvered by one man

construction over a sponson vessel is first, that it is much stronger for wharf bumping, the point of contact being the apex of the angle formed by the main beams and frames of the vessel, joined by strong brackets, and the heavy guard channel.

Secondly, the carrying of the shell plating over the extreme width of vessel enhances stability and affords increased resistance to upsetting when the vessel takes a list by loading cars on one side.

The effect of this construction as shown



This 500 s.h.p. Kromhout marine unit is one of the few surface-ignition oil-engines constructed up to this power. Several ferry and other types of passenger craft in Holland have this oil-engine installed. Two 80 s.h.p. Kromhout oil-engines are installed in the Canadian ferry "Jacques Cartier"

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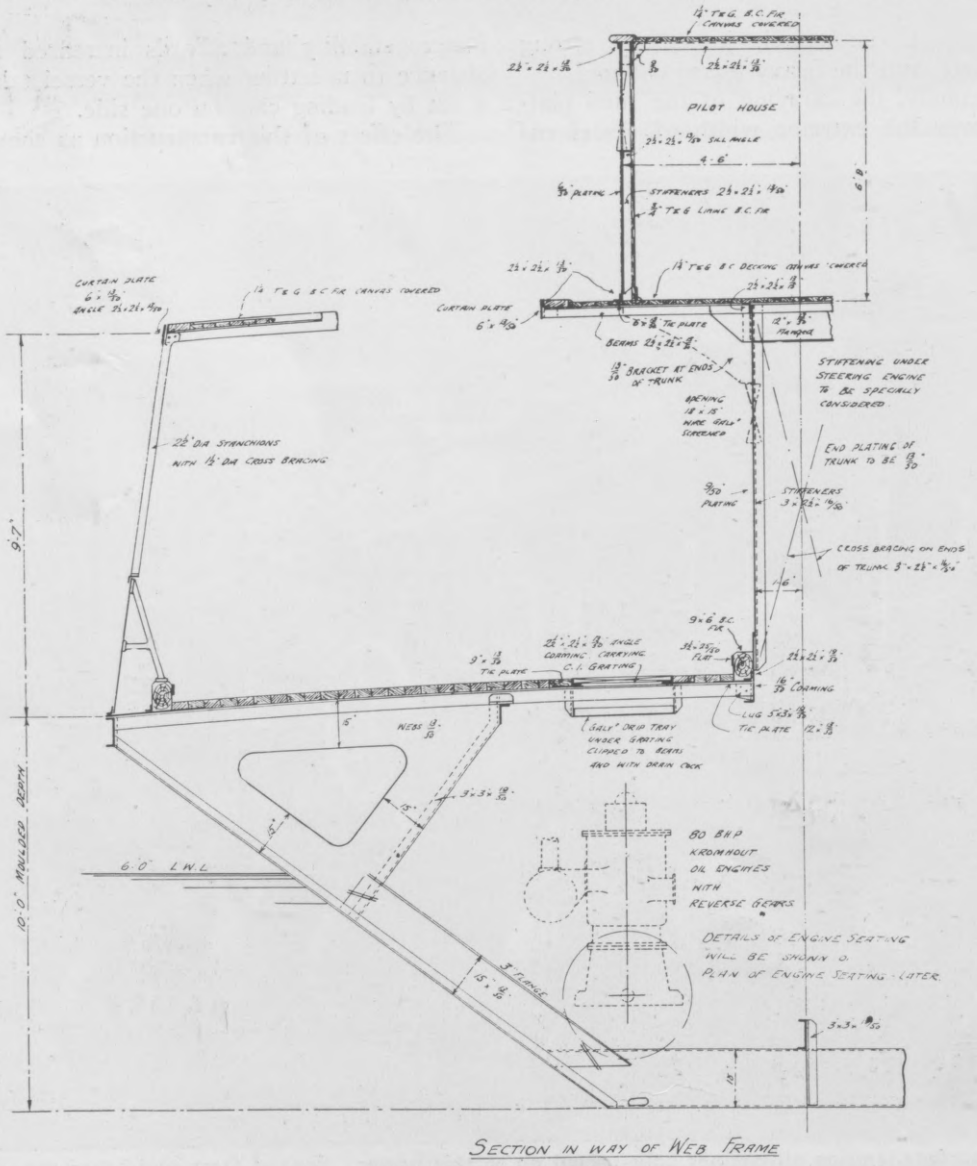
in the plans is not exactly pretty, although the waterlines and buttock lines are quite satisfactory. Actually, however, most of the unsightly effect is in the underwater portion and from the photographs it is obvious that the vessel is really no "homlier" than the average ferry built on much more expensive lines.

The JACQUES CARTIER was built by the Davie Shipbuilding & Repairing Co., Ltd., of Quebec, to the order of the Lachine Ferry Co., Ltd., who have for nine years been operating steam ferries between Caughnawaga and Lachine, which is part of one of the main traffic arteries from the States into Montreal. The vessel is 135′ long overall, 35′ beam, 10′ moulded depth, and is specially reinforced by lattice pillaring, web frames and deep brackets.

So much for the hull—but careful consideration of the problem evidenced that nothing but oil-engines would answer machinery requirements, for while there may not be a great deal of difference between steam and oil-engines so far as first cost is concerned, it was obvious that if a low first cost was necessary, reduced operating expense was also essential.

The JACQUES CARTIER is engined with two 80 b.h.p. Kromhout surface-ignition engines, these being two-cylinder models with reverse gears and running at a speed of 350 revs. per minute. While this make of engine is unfamiliar on this side of the water, it is in fact one of the pioneer European semi-Diesels, as it is one of the most consistently successful.

The hull of this oil-engined ferry has simple, easy lines


PILOT HOUSE
CURTAIN PLATE
22" DIA STANCHIONS WITH 1½" DIA CROSS BRACING
STIFFENING UNDER STEERING ENGINE TO BE SPECIALLY CONSIDERED
END PLATING OF TRUNK TO BE
CROSS BRACING ON ENDS OF TRUNK
SALT DRIP TRAY UNDER GRATING CLIPPED TO BEAMS AND WITH DRAIN COCK
80 B.H.P. KROMHOUT OIL ENGINES WITH REVERSE GEARS
DETAILS OF ENGINE SEATING WILL BE SHOWN ON PLAN OF ENGINE SEATING LATER
6'-0" L.W.L
10'-0" MOULDED DEPTH
9'-7"

SECTION IN WAY OF WEB FRAME

Hull of oil-engined ferry is sturdily yet inexpensively constructed and offers low resistance to passage through the water

The Kromhout is manufactured in a wide range of models, those of 9 to 200 b.h.p. being fitted with reverse gears and clutches, and those from 200 to 500 b.h.p. being directly reversible by compressed air. It is being distributed on this side of the water by the Crude Oil Engine Co., Ltd., of Montreal, Canada, who have since the beginning of the year made several other installations of this particular engine. We understand that they intend carrying a stock, not only of spare parts but also of various complete models up to 100 b.h.p.

The contract for the JACQUES CARTIER was placed early in January, the keel was laid in March, the vessel was launched on May 22nd, and the engines connected up the next day, when a preliminary trial was run. On the following day, May 24th, an official trial was made in Quebec Harbor early the next morning the vessel left Quebec for Lachine, making the 180 miles a virtually non-stop run, a halt only being called at Sorel as it was not desired to run the river at night.

An interesting example of one advantage of an oil-engine installation over a steam job, *viz.*, the ability to get into operation with no preliminaries, is the fact that half an hour after boarding the vessel at Sorel (everybody having ashore for the night) the vessel was undergoing speed trials on the measured mile. Her average speed, for and against the current, was 10.66 miles on the mile, and there is little question but that she will be good for 11 miles when the en-

(*Continued on page* 521)

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(*Continued from page* 516)

gines have run in a little. As a 9-mile speed only was guaranteed the result was satisfactory, while it is equally obvious that the novel lines are not incompatible with speed. It would be difficult indeed to improve the performance with any lines, 160 b.h.p. not being very much power to drive a 35 car ferry.

An interesting feature of the installation is that by a system of levers and gears the engines, after starting, can be controlled, both as regards speed and reversing, from the pilot house, which is a very desirable quality in the case of a ferry which has so frequently to make wharf landings.

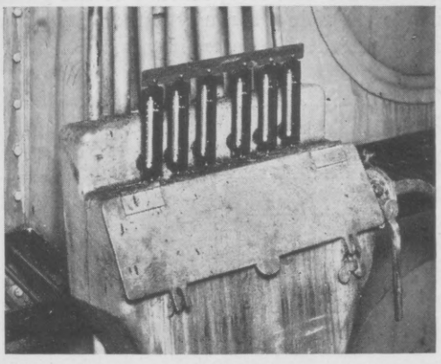
The vessel handles very easily and reliably by a hand-steering gear, though it is expected that the deck control of the twin engines will almost eliminate the necessity for steering control.

The ability of a ferry to stand up under a one-sided load is of some importance, a quality which was tried out by placing 82 men on the rail. This was equivalent to a weight of about six tons, and the resultant list was only 2½°. A 5° list would have been considered satisfactory. Her draft is 5 ft. 6 in. with 30 tons of ballast aboard. She is now in active service and her economies and performance will be watched with interest by all those concerned in the manufacture and use of similar equipment.

Control of Temperatures in Motorship Operation

Thermometers and Instruments Have Frequently Been Found Superior to Reliance on the Operator's Sense of Touch and One of the Most Important Temperature Indications, That of the Exhaust Gases, Can Be Given Only by Instruments

THE observation of temperatures constitutes one of the most important uses to which the operator of an oil-engined ship ordinarily puts his sense of touch. But because of the notorious unreliability of this faculty the use of instruments to supplant it is rapidly on the increase in the operation of modern motorships.

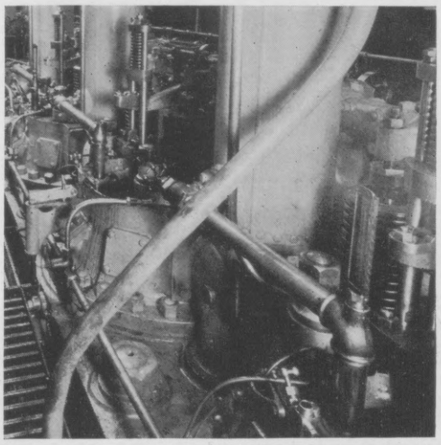


Thermometers play important part in control of cooling water for oil engine of the "Silverelm." See page 511

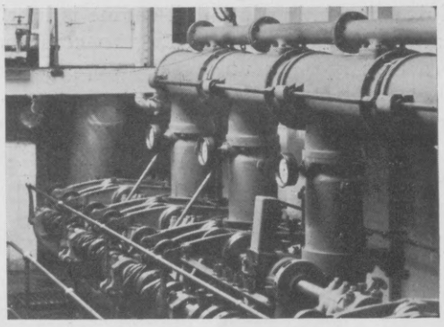
What may feel hot to one person may feel cold to another and to the same man the identically same object may simultaneously feel both hot and cold. A simple experiment to demonstrate this consists in preparing three bowls of water, one extremely hot, the other extremely cold and the remaining one luke warm. If one hand is put in each bowl until it is fairly accustomed to the temperature and both of them are then dipped into the luke warm bowl, the latter will feel positively hot to the cold hand and correspondingly cold to the warm one.

In view of these facts it is almost superfluous to emphasize the great importance which temperature measuring devices play in the equipment of a modern motorship power plant. Stress has thus far been laid on the detection of operating defects based on temperature indications but modern practice is inclining more and more towards the systematic notation of the temperatures of the various fluids used in an oil-engine to ensure successful and economical operation. Any power plant has a great variety of circulatory systems consisting of vapor, fluids and gases. In the oil-engine the largest volume of anything that is circulated through the engine consists of air and exhaust gases produced from it. There are in addition to that cooling water and the various branches into which this circulatory system is subdivided. Fuel-oil, lubricating oil and in a great many cases injection air with the subdivisions found in the suction, discharge, and intercooling piping attached to the air-compressor.

In feeding fuel-oil to the engine it is common practice to pump the same from the double-bottoms or storage tanks of this ship, which is known as a daily service tank. Located in this are heating means of one kind or another, the purpose of which is to reduce the viscosity of the oil and thereby facilitate the settling out of water and impurities and to permit of its being more readily handled by the fuel-pump of the engine. Overheating the oil is likely to be wasteful of the heating means employed, and may be dangerous because of the liberation of high volatile constituents of the oil capable of taking fire. Too low a temperature will impair the efficiency of settling and will cause the oil to flow sluggishly through the strainers and will interfere with the best action of the fuel-pump. Settling tanks are, therefore, almost invariably fitted with thermometers to guard them against the inaccuracy of the temperature sense with which nature endowed human beings. With the increasing use of centrifugal purifiers for preparing fuel-oils accurate temperature control is indispensable if a convenient method of operation is to be secured. Slight changes in the temperature of the oil naturally bring with it changes in its specific gravity which, if not controlled, will continually require readjustments in the purifier.



Cylinder cooling water discharges of motorship "Ashbee" are protected by mercury thermometers



Dial thermometers show exhaust temperatures on the "H. T. Harper"

In the operation of air injection engines it is highly expedient for the operator to be thoroughly posted at all times as to the temperatures of the air leaving the three stages and that leaving the intercooler. In modern three-stage compressor practice the rise in temperature per stage is between 200 and 300 degreees Fahr., as shown on the discharge pipe, but at the moment of maximum pressure in the stroke of the piston this is likely to be exceeded. A properly lubricated compressor will show a certain amount of discoloration of the air passages when opened-up as the result of a partial carbonization and decomposition of the oil which is fed. If lubrication is too meagre, it is obvious that the compressor will wear unduly, whereas if too much oil is fed, carbonization and partial decomposition become excessive and further increase the temperature of the air discharge from each stage. Hot discharge air is also frequently caused by leaky piston rings and valves which have the effect of wire

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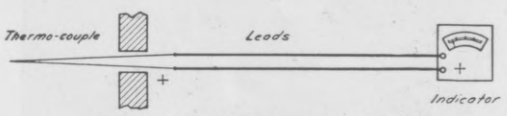
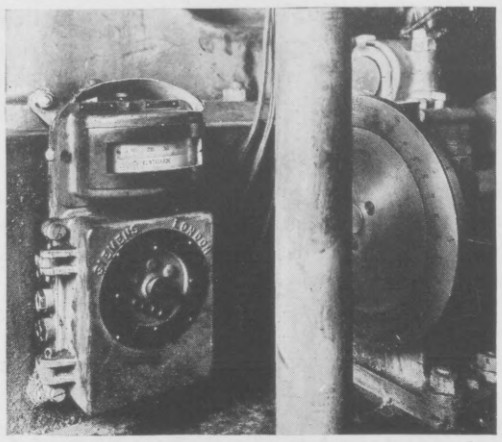
drawing the air and heating it by internal friction. Effects similar to this may, under some circumstances, be produced by the discharge passages becoming clogged with partially consumed oil residues, a condition which will, of course, also manifest itself on the pressure gauges of the various stages. Air leaving the different intercoolers will vary in temperature according to the condition of the tubes and cooling surfaces. If they have been allowed to become coated on the inside with lubricating oil residues or on the outside with scale, the efficiency of cooling is bound to be less and an increase in temperature of the air supplied to the next stage will naturally manifest itself. The temperature fluctuations due to the causes here enumerated are rarely pronounced enough to be discernible by the sense of touch and the systematic logging of temperatures recorded by means of thermometers forms an effective safeguard to protect the compressing installation from trouble.

Not least among the remaining vital fluids circulating in an oil-engine is lubricating oil, which, according to common practice, is quite universally supplied to the engine by a force feed return circulating system. Controlling the temperature



Elements of pyrometer wiring

of this oil is important, not only as a means of checking up operating conditions, but also of keeping the oil itself in an efficient lubricating condition. Everyone knows that the viscosity of an oil walls off sharply with rising temperature, and it is a good practice, therefore, to maintain the temperature of force-fed oil as low as the conditions of the installation make practicable. Thermometers placed on the returns from various parts of the engine give a ready means for determining whether any of them are being exposed to more than a running heat. Cooling water must be watched as regards temperatures in order to prevent the deposition of scale in the engine jackets which results when not enough is circulated, and to prevent the engine from running at low efficiency if the water is kept too cool. As in the case of lubricating oil temperatures, the condition of the cooling water supplies and discharges should be known for the purpose of maintaining the engine as a whole in proper condition and of keeping tabs on all individual parts. When a ship is running in the tropics and is being supplied with relatively warm water, it is essential that the supply be increased in order that an injurious discharge temperature may not arise, and in passing through arctic waters the pumps must be throttled if abnormally low temperatures are to be avoided. Here, again, the fitting of thermometers on the supply pipe to the engine and on



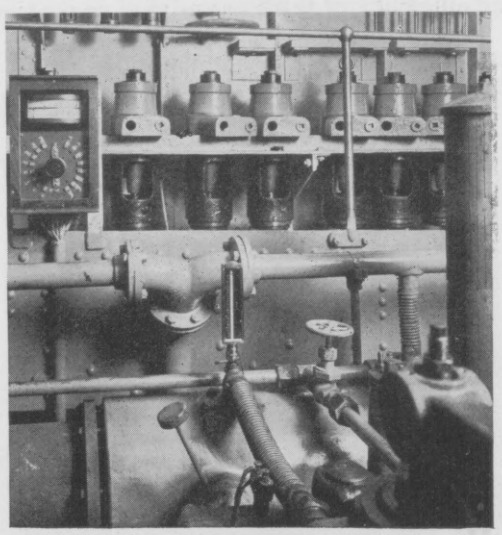
An electric pyrometer helps to maintain the efficient operation of the "Silverelm"

the overflows from the various cylinders, exhaust valves, intercoolers and other parts containing circulating water is a means for improving the operating efficiency of the vessel.

Whereas the temperatures discussed so far could all be handled in a pinch by the sense of touch, the most important of all, which must be observed in the running of an oil-engine, could under no circumstances be determined by hand. This is the temperature of the exhaust gases.

The temperature of the gases at exhaust is connected by a simple relation to the temperature and volume found at the end of the combustion process just after the last trace of fuel has ceased to burn in the cylinder. Roughly speaking, this point occurs when the piston has moved back from the dead center about one-eleventh of the stroke and when the temperature is around 2,800 degrees Fahr. If the engine is running normally, there is no more combustion during the ensuing expansion, and the final temperature depends upon the reduction from the 2,800 degrees which results merely from the change in volume of the entrapped gases. In other words, as soon as combustion is over the expansion process serves to cool the gases right down to the point where the exhaust valve opens.

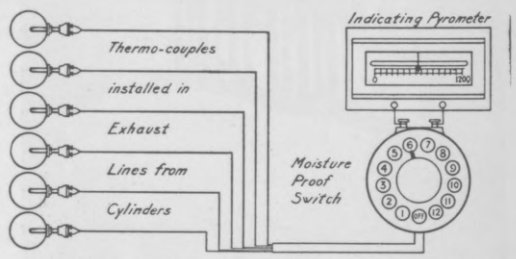
In actual practice, however, even in a perfectly running engine a certain amount



Diesel-electric hopper dredge "A. Mackenzie" has many thermometers for cooling water and lubricating oil; also three electric exhaust pyrometers

of after-burning is always present—that is, the combustion is not entirely completed at the moment when the so-called constant pressure burning ceases and the indicator lines begin to drop. Fuel which burns during the expansion raises the temperature during the latter part of expansion, does not produce its full share of power, raises the mean temperature of the cylinder and is undesirable in every way. In setting the combustion of any cylinder, it is therefore the aim of the test engineer to reduce after-burning to so small an amount that these effects do not play an important part, and in all cases there is no trouble whatever about doing this.

Since it is impossible to note the temperature of the gases while they are still in the cylinder, the next best thing that can be done is to observe them at the moment that the exhaust valve opens. As has been seen, the amount of after-burning which has occurred determines the extent to which the cooling, due to expansion, is partly neutralized; this manifests itself in the end-temperature of the gases and is capable of ready observation by means of suitable instruments. The tem-



Selective switch allows temperature of many cylinders to be read on one instrument

perature range of the exhaust gases is under all circumstances far too high to permit of being even estimated by the human touch, and the fitting of instruments either in the form of thermometers or pyrometers on the exhaust is, therefore, coming to be recognized more and more as standard practice.

In discussing exhaust temperatures thus far stress has been laid simply on the matter of after-burning and the degree to which it occurs. There are a number of other matters, however, which may be indicated by fluctuations in the temperature of the exhaust. First among these is, of course, the load on the cylinder. Being higher naturally for the greatest loads and lowest for no load or even misfiring. Accurate temperature control, therefore, becomes a means for judging not only the load on the entire engine, which is sometimes not easy to do by other means while running at sea, but also makes it possible to determine whether all the cylinders are getting the same load or not. Balancing the load among the different cylinders is determined by the setting of the fuel pump, but imperfections in the latter caused by faulty original setting or disturbances arising out of leaky or sticky tappets is likely to throw out the balance and to cause some cylinders to be overloaded while others are idle. Overloads,

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as everyone knows, are best avoided in oil-engines, except if compensating means such as supercharging are provided. Should any cylinder be getting more fuel than its share, the exhaust thermometer or pyrometer will at once give a clear indication and will allow the operator to adjust the fuel-pump until the temperature and the load associated with it both become normal.

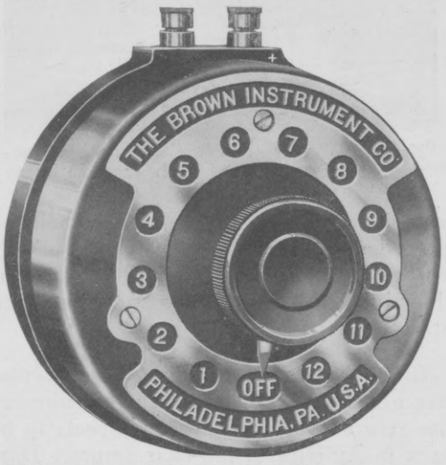
Single-plunger fuel pumps with only a very rudimentary means for distributing the load on the various cylinders have been used by some large and very successful marine engine builders, and it has been their practice to adjust the load on the various cylinders entirely by reference to the exhaust temperatures. This fact alone gives striking evidence of the sensitiveness with which exhaust temperatures may be used as a means for controlling the working of an oil-engine.

Defects in adjustment will also be registered by an exhaust thermometer or pyrometer. If an exhaust valve is leaking, combustion is bound to be more sluggish, and will extend over more than its allotted fraction of the stroke and will raise exhaust temperatures by the burning already referred to. A late opening of the spray-valve, which causes the introduction of fuel when the piston is already well on its way down the stroke, will similarly cause after-burning and will show up in the exhaust temperature. If the time of opening of the spray-valve is correct, but if its orifices have been clogged for any reason, a late introduction of fuel will also result with consequences similar to those already noted. Low injection air pressure has the same effect and is emphasized even more by the fact that large and imperfectly atomized drops of fuel will burn for a long time down the stroke, and will cause a pronounced rise in the exhaust temperatures.

Insufficient cooling water and hot cylinder parts reduce volumetric efficiency, prevent an adequate charge of air from being aspirated and result in sluggish combustion in after-burning, such as will show up in the exhaust temperatures. An experience had with an engine whose cylinder barrel was badly scaled up amply demonstrates this. The scale allowed the cylinder to heat up, prevented sufficient air from being drawn in and resulted in reducing the capacity of the cylinder to burn fuel. Smoky exhaust and high exhaust temperatures were the result, and the cylinder in question could not be made to act properly until its jacket had been freed from scale and its volumetric efficiency brought back to normal.

An ordinary mercury thermometer for the measurement of exhaust temperatures is not entirely suitable, because the range encountered, which varies from 300 to 1,000 degrees, is somewhat higher than can be successfully withstood by most standard mercury instruments. Excellent types of a special thermometer for this purpose are, however, available and are

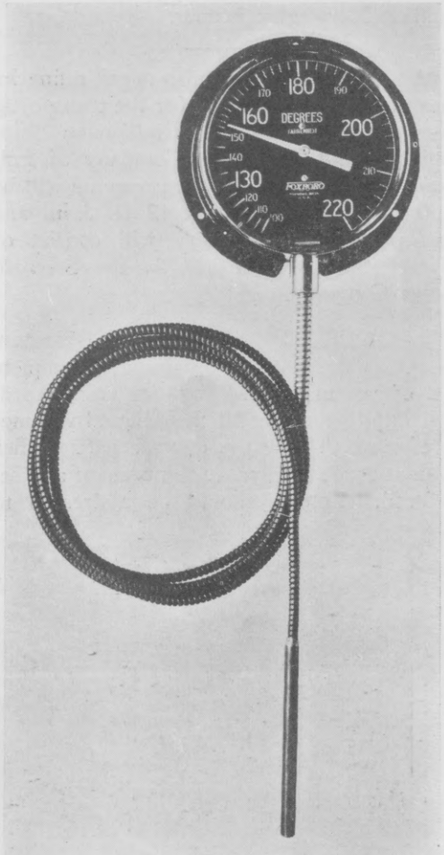
Pyrometer consists of a standard millivoltmeter calibrated to read in degrees



Multi-pole switch allows reading to be taken on any desired cylinder

fitted with a steel jacket surrounding the mercury bulb. They are fitted on each exhaust elbow and permit of a direct and continuous observation of the combustion conditions within the engine.

Another form of temperature recording instrument suitable for exhaust measurements is the electric pyrometer, which is not nearly as complicated as its rather



Dial-thermometer suitable for indicating exhaust temperatures

scientific name would imply. Its method of working is based simply on the fact that if the two wires consisting of dissimilar metals are joined by welding or otherwise, and if the junction thus formed be kept at a temperature higher than the two free ends of the wires, an electromotive force will be set-up at the junction. The free or cooled ends are simply connected by suitable leads of an ordinary millivolt meter which is calibrated to read in degrees rather than volts. This method of temperature measurements can easily be extended up to temperatures of 3,000 degrees or more, which is naturally far beyond anything encountered in exhaust gas measurements.

The junction of two dissimilar metals, called a thermocouple, is allowed to project into the exhaust elbow in the same manner as the bulb of a mercury thermometer, and at the outside end of the couple terminals properly armored and encased are fitted for attaching the leads to the millivolt meter. The leads themselves are placed in conduits similar to those used for the lighting wires, of which a large number are used in the engine-room anyway. No matter how many cylinders an engine or pair of engines may have, only one millivolt meter need be used. A multiple throw switch permits of connecting one cylinder after another with the instrument so that its indications may be observed even more rapidly than a man could climb around from one cylinder to the other, observing the temperatures of each one individually. The operating engineer makes this a regular part of his rounds and log books most recently printed contain boxes for the recording of exhaust temperatures on each watch. Should any abnormality in these develop, it is at once apparent to those responsible for the running of the ship and the necessary measures for detecting and remedying the improper condition to which it is due can be taken without delay. If the rise or fall in temperature is not serious, the matter need not entail a shutdown of the engine, and suitable entries in the log will insure an inspection and overhaul of the affected cylinder at the next stop in port. It is perhaps superfluous to point out the enormous saving in overhaul work which is thus made possible. Rather than indiscriminately examining exhaust valves every time the ship is at the dock, only those parts which the temperature readings have shown to be abnormal need be pulled-out and inspected, with the result that the time and work of the crew can be applied to those parts of the engine where it is most needed. Temperature controls of all the items listed in this article are, therefore, among the high-efficiency modern operating methods which are beginning to characterize the maintenance of motorships more and more.

It will not be long before temperature instruments will be a standard part of all engine-room installations.

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Interesting Notes and News From Everywhere

THERE are now 137 motorships of 1,621,892 tons displacement equipped with Burmeister & Wain type Diesel engines.

Another of the motorships for the Bank Line was launched by Harland & Wolff, and is the fifth of the series. She is named GLENBANK.

AKAGISAN MARU, the first of three new motorships for Mitsui & Company, will load on the Columbia River for the Orient during September next.

Up to a recent date the motorship SELANDIA placed in service in 1912 has run 580,190 nautical miles, illustrating the service which can be gotten from Diesel engines and cargo ship operation.

A 60 hours non-stop test of a 1,800 s.h.p. at 90 r.p.m. Wallsend-Sulzer Diesel engine has just been completed. It is a four-cylinder engine, 23.62" bore by 47.24" stroke and will be installed in a single-screw ship.

Direct-reversing Diesel engines, reduction-gear Diesel-drive, pneumatic-transmission Diesel-drive, Diesel-electric drive, were all developed and commercialized by the Russians years ahead of other countries.

The motorship CARISSO, converted from a Shipping Board steamer, left Portland, Oregon, April 28th, on her first trip beween this port and the Hawaiian Islands in the service of the Oceanic Steamship Company.

The gasoline-engined yacht, SPEEJACKS, famous for its trip around the world, is being equipped with Bessemer-Atlas Diesel engines. When the installation is completed, a second voyage around the world will be made.

A Chaleassiere ten-cylinder 6,000 s.h.p. at 280 r.p.m. Diesel engine of the two-cycle type has been ordered by the French Ministry of Marine from the Establissements Leflaive, of Paris and St. Etienne. It will be installed in a submarine.

May was the second month of this year during which the volume of business done by the S. F. Bowser Company exceeded $1,000,000. They are widely known to the oil engine trade because of their lubricating oil filters and force-feed apparatus.

World's Record of New Construction Ship's Performances and Other Matters of Note in the Motor-Vessel and Oil Engine Industries

"Katherine" tows cannery scows at a fraction of cost of towing with gasoline boat

Boris Hagelin, special U. S. Representative of the Swedish Nobel Diesel Company has returned to Europe, but expects to be back in America in the near future. During his absence the affairs of the company wil be handled by Francis Rooney, their attorney, who has offices at 43 Exchange Place.

Three of the earliest ocean-going steamships to be converted were the SONGDAL, ex-FOLKVARD, ex-BANDON, the SONGVAR, ex-LANDVARD, ex-CHAMPON, and the SONGVAND, ex-LIDVARD, ex-PANGON. These single-screw motorships have been purchased from S. O. Stray & Co. for two million Norwegian kroner.

An association of Danish sugar refineries has ordered a motorship for the transportation of syrup, from the Rodbyhavn Shipbuilding and Dry Dock Company of Lolland, Denmark. Her measurements will be 130 ft. x 24 ft. 6 in. x 12 ft. 3 in. and her propelling machinery will consist of Diesel engines furnished by the Swedish Atlas Company.

The U. S. Patent Office at Washington, D. C. is desirous of obtaining a complete set of volumes of MOTORSHIP from April, 1916 up to the present date, bound volumes preferred. Under the law the patent office cannot agree in advance to purchase any set offered. Letters should be addressed to The Commissioner of Patents, Department of the Interior, U. S. Patent Office, Washington, D. C.

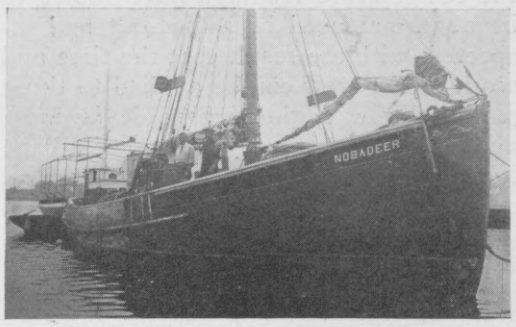
INVERBANK, briefly described on page 345 of the June issue of MOTORSHIP will probably arrive in New York at the time when this issue comes off the press. She is the first of the 10,000-ton class of motorships completed at the Harland & Wolff shipyard and will go into the Far East service of the American Oriental Line, of which Houlder, Weir & Boyd, 17 Battery Place, New York City, are agents.

Probably the first large passenger steamer to be converted to motor power was the IMPERATRITZA ALEXANDRIA, which was equipped with twin 600 s.h.p. Nobel two-cycle Diesel engines in 1916. She carried 1,000 passengers and 500 tons of cargo at 13 knots speed. The crankshaft bearings of these engines were lubricated with boiler fuel-oil, the latter after becoming too thick to circulate was used for firing the donkey-boiler.

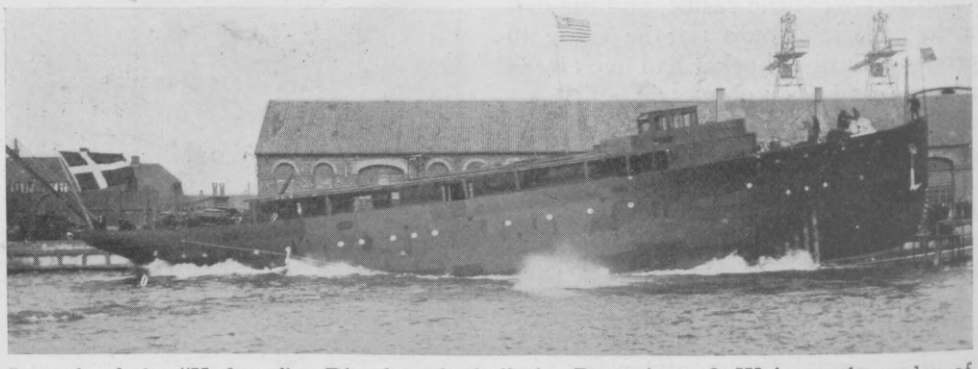
A careful analysis of the conditions surrounding the design of a 20,000-ton Diesel electric liner has been published by Percival J. Higgs, Wh. Sc. Starting out with the geared submarine Diesel installation on the Hamburg-American motorship HAVELLAND, he works out specifications for a high-speed oil-engined electric plant and makes a detailed analysis of its operation and costs for a liner of the size given and running at a speed of 16 knots.

Evidently Alfred Holt & Co. of Liverpool are satisfied with the performance of the maiden voyage of the "motor-steamer" DOLIUS, powered with combination steam and oil-engines, as they recently ordered another vessel of the same type but of larger and greater power, namely, 425 ft. length and 4,000 s.h.p. in twin screws, from the Scotts Shipyard, Greenock. The motorship CENTAUR was recently launched at this yard to the order of Alfred Holt & Co.

The GLENSHIEL, a twin-screw motor vessel of about 9,500 gross tons built for the Glen Line Ltd. by Harland & Wolff, Ltd. was delivered to the owners after un-



Nantucket fishing boat, oil-engined, goes to the catch and returns to market in all weathers



Launch of the "Vedette," a Diesel yacht built by Burmeister & Wain to the order of F. W. Vanderbilt of New York

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dergoing successful trials in Belfast Lough on the 21st of May. The propelling machinery of the GLENSHIEL consists of two sets of Diesel engines of the Burmeister & Wain-Harland & Wolff type. Each engine develops 3,000 I.H.P. when running at 115 r.p.m. and has 8 cylinders 29⅛ in. bore and 45¼ in. stroke.

Installation work has been started on the Diesel engines for the American submarines V1, V2, and V3, at Portsmouth, where the hulls are building. In each boat two Busch-Sulzer Diesel engines of 2,250 b.h.p. furnish power for direct drive. In addition, there are two Bureau-of-Engineering type Diesel engines of 950 b.h.p. direct-connected to generators for providing electric drive up to 11 and 12 knots speed. For over this speed the two large Diesel engines are brought into action.

Having been equipped at the time when she was built in 1902 with a gasoline engine, the workboat KATHERINE has recently been fitted with a 45-b.h.p. Fairbanks-Morse heavy-oil engine and a 42 in. x 26 in. pitch propeller. As a result she now makes 10 knots speed and has plenty of power for towing refuse scows from the East Maine sardine factories to the reduction plant of the Seacost Canning Company at Eastport, Maine, also for towing logs to their box shook and saw-mill. Her dimensions are 47 ft. x 12 x 4 ft. 8 in. and she measures 14 tons.

In 1918 Nobels started work for the Russian navy on a set of four 8-cylinder Diesel engines of 2,500 s.h.p. each at 250 r.p.m. for large submarine cruisers. It is believed that these engines are now being finished at the Russian Diesel Works, Petrograd (the nationalized Nobel plant) by the Bolsheviks. Two engines in each boat were directly connected to the propellers, while the others charged the accumulator which could furnish power for motors on the propeller shafts in time of high speed requirements. This gives these submarine-cruisers a total power of nearly 10,000 s.h.p.

NOBADEER is a sturdy Nantucket fishing boat of 23 gross tons with dimensions of 53 ft. x 15 ft. x 6 ft. aft and although she is rigged to carry sail, her main dependence is on a 46-h.p. Wolverine heavy-oil engine. This was installed exactly a year ago and has given the boat a speed of 8 knots on her regular fishing trips and runs to the market in all kinds of weather. Only 2½ gallons of fuel are consumed per hour and there have been neither expenses nor delays on account of work done on the machinery since the time when it was first started. Captain Stirnus is thoroughly satisfied with his vessel.

While we are not in favor of the Navy Yards receiving contracts for Diesel engine construction when private companies, whose plants have especially been devoted to naval type oil engines, have no work of this type on hand, we record as a matter of general interest the fact that a contract for three Bureau-of-Engineering type Diesel engines, involving $250,000, has been placed by the Navy Department with the Brooklyn Navy Yard for installation in a mine-laying submarine. Two of the engines are of 1,400 h.p., and will be direct-driven, while the third engine is of 500 b.h.p., and will be coupled to a generator for providing electric power for a slow-speed cruiser.

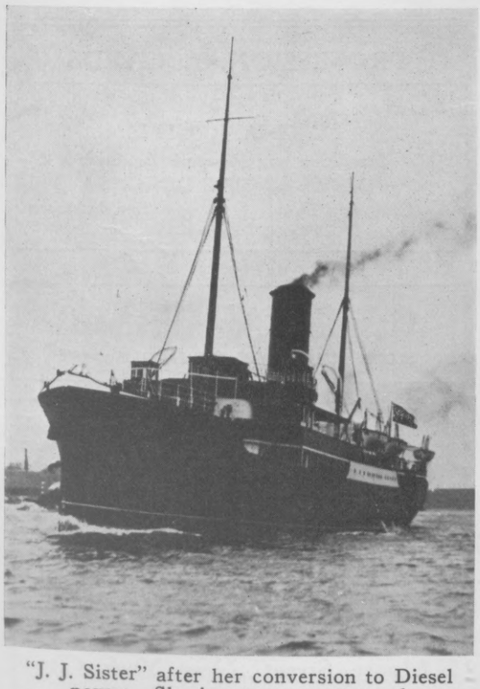
ZOROASTER, the new 1,600-b.h.p. Nobel motor tanker, which was fully described in our June issue, arrived in New Orleans (Baton Rouge) on June 16, after having made the voyage from Alexandria, Egypt, in 20 days. Owing to the heavy head gales encountered on her maiden voyage, it was impossible for her to realize her full speed at that time, but on her second westward voyage just completed, she showed what she can do by arriving two days early.

During its seventh annual meeting held in Philadelphia on May 12 the Atlantic Coast Shipbuilders' Association took definite steps towards a constructive plan of action for conserving American shipyards as an important factor in the deveolpment of the American merchant marine.

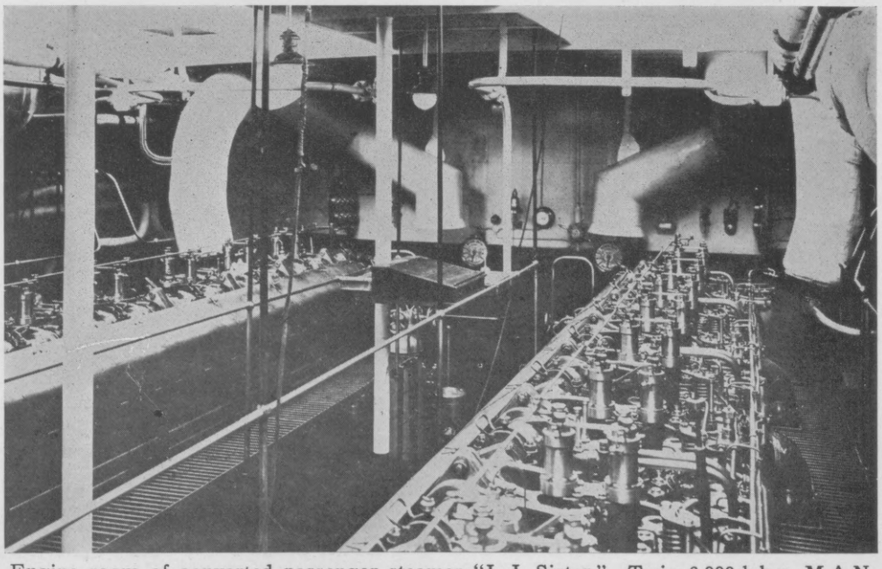
Trials of Converted Steamer "J. J. Sister"

LAST month details were given of the conversion of the Spanish passenger and cargo steamer J. J. SISTER into submarine type Diesel drive. This vessel, it will be recalled, is owned by the Compania Transmediterranee of Valencia, Spain, and her twin steam engines together developed 5,810 i.h.p. at 110 r.p.m., giving her a speed of 17½ knots. The steam plant consisted of two double-Scotch boilers and reciprocating engines. Her new power plant consists of two, ten-cylinder submarine type Diesel engines, together aggregating 2,800 shaft h.p. at 200 r.p.m. direct-connected to the propeller shafts. They give the vessel a speed of about 15 knots.

Through the courtesy of the directors of the Fijenoord Shipyard, our Dutch correspondent, S. Snuyff, attended the trials which passed off successfully, a speed of 15½ knots being easily maintained. Tests were made in order to ascertain the influence of the high engine speed on the vibrations of the ship, particularly on the aft deck. It was noted that whenever one engine turned at a different speed from the other, the vibrations disappeared for a period, but reappeared at intervals whenever the engines were synchronizing. The voyage from Rotterdam to Cartagena, Spain, was made in 100 hours, the engines averaging 204 r.p.m., the sea speed of the ship being 15.88 knots.



"J. J. Sister" after her conversion to Diesel power. She is a passenger vessel



Engine room of converted passenger steamer "J. J. Sister." Twin 3,000-b.h.p. M.A.N. submarine Diesel engines are used at 1,400 b.h.p. each with direct drive to propeller shafts

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Wolverine-engined "Messenger" bucks ice-bound lake waters between Sandusky and Detroit. She carries produce for Capt. John P. Neuman, of Sandusky, practically all the year round

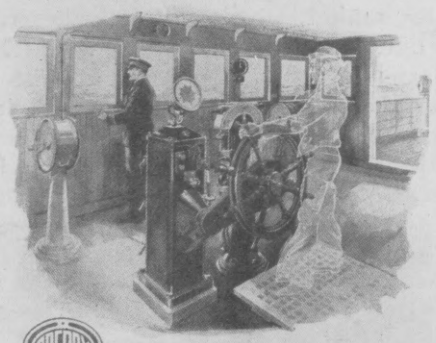
Dr. Foerster at Propeller Club

SPEAKING as the guest of honor at a semi-monthly luncheon of the Propeller Club, Dr. Ernst Foerster, editor of one of Germany's leading shipbuilding periodicals, naval architect, and designer of the LEVIATHAN, spoke interestingly about three inventions relating to the propulsion of ships. These are the geared Foettinger hydraulic clutch and speed transformer, the Flettner rudder, and the Star contra-propeller. Owing to the fact that builders of motorships are generally progressive enough to take advantage of the most up-to-date equipment as soon as it has been demonstrated, it appears safe to infer that the three new devices discussed by Dr. Foerster will be found to preponderate in the construction of oil-engined ships.

As was fully discussed in MOTORSHIP for February, 1924, the hydraulic transformer consists essentially of a centrifugal-pump impeller mounted on the shaft of the engine and driving an hydraulic turbine rotor running in the same casing. Guide vanes suitably direct the moving water from one to the other and the arrangement has an advantage of over 95 per cent. Declutching is accomplished by draining the casing. The Flettner rudder is capable of hand operation for ships up to 8,000 tons, owing to the fact that there is mounted on the main rudder an auxiliary vane which utilizes some of the dynamic energy of the water flowing past the stern to deflect the main rudder. Means are provided for hand-operating the auxiliary vane and power apparatus for steering is dispensed with. The contra-propeller is a set of stationary blades mounted on the rudder frame close behind the normal propeller. By directing the whirling and more or less turbulent flow leaving the blades of the screw, the blades of the contra-propeller increase propulsive efficiency in the same way that guide vanes improve the efficiency of an hydraulic turbine and it is claimed that the device increases the available useful power by 10 per cent.

One of the main purposes of Dr. Foerster's visit to the United States was to assist in building up co-operation in trade and technical matters, in which progress is already well under way. In his magazine, Werft, Reederei & Hafen, Dr. Foerster will from now maintain a regular section featuring oil-engined vessels.

Cash Prize Contest



SPERRY

Submit a Title for this Picture

The above picture shows "Metal Mike" in control of the ship with a phantom of the traditional quartermaster at the wheel. A title for this scene such as "The Traditional Helmsman Succeeded"; "Today and Yesterday"; is desired.

The Contest opens June 1st and closes August 31st. PRIZES: $100.00 First Prize down to $5.00.

Mr. T. H. Rosebottom, General Manager, of the United States Lines, New York; Mr. J. L. Luckenbach, Vice-President, of the Luckenbach Steamship Co., New York; and Captain D. S. Killer, Marine Superintendent of The Cunard Steamship Co., Ltd., New York, have kindly consented to act as judges in this Contest.

See full details and rules of the Contest given elsewhere in this issue.

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A prize is offered for the best title to this picture

A Gyroscopic Puzzle

Reproduced herewith is an illustration of a pilot wheel operated automatically by means of a gyroscopic mechanism and without the assistance of a man. The phantom of the superseded quartermaster shown standing in front of the wheel draws attention in a striking manner to substitution of machinery for the human hand and brain. Prizes ranging from $100 down to $5 are being offered by the Sperry Gyroscope Company for the best title to the picture, and a number of persons prominent in local marine circles will judge the winners.

Keen interest in the contest is expected.

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